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**ARMSTRONG LABORATORY (AL) ANALYTICAL SERVICES
PROCESS IMPROVEMENT TEAM (PIT) - AIR FORCE
TEAM QUALITY AWARD APPLICATION**

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ANALYTICAL SERVICES DIVISION
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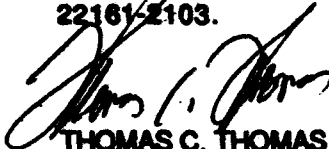
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13. ABSTRACT (Maximum 200 words) Headquarters, Air Force Materiel Command (HQ AFMC) nominated the Armstrong Laboratory (AL) Analytical Services Process Improvement Team (PIT) as one of two HQ AFMC Teams to compete for the Air Force Team Quality Award. The evaluation was based on a ten-page application and a 15-minute oral presentation. The application (this report) included a description of teamwork, process selection criteria, analysis techniques, solutions, results, deployment, and presentation. The team's mission was to improve the support the Surgeon General is providing for Environmental and Occupational sample analyses. AL's PIT Team was selected one of five Air Force Team Quality Champions at the Quality Air Force Symposium "The Quest for Quality" in Montgomery, Alabama, 19-22 October 1993. The Teams results showed overall 20-30% improvement in analysis turnaround times, with better results in specific process steps, e.g., reduction in paperwork delays following analysis.				
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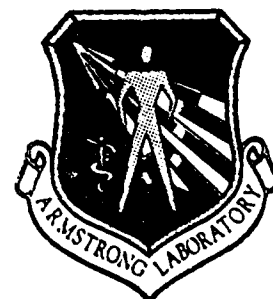
AIR FORCE TEAM QUALITY AWARD



1993 APPLICATION

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ANALYTICAL SERVICES PIT
ARMSTRONG LAB, HSC, AFMC
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NOMINATION FORM

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Team Members: See Attached Sheet

SUMMARY OF UNIT'S MISSION

The Analytical Services Division, to which this Process Improvement Team (PIT) belongs, is part of the Occupational and Environmental Health Directorate, Armstrong Laboratory, headquartered at Brooks AFB, TX. The Analytical Services Division provides Analytical Chemistry Services in support of Air Force Environmental Pollution Control and Occupational Health Programs. We respond to over 250 base level customers who send over 75,000 samples to the laboratory annually. These occupational and environmental samples include substances contained in air, water, soil, vegetation, hazardous waste, industrial materials, and biologicals. The laboratory employs 55 chemists, technicians, and other support personnel; and utilizes \$5-6 million of complex, sophisticated instrumentation.

The Analytical Services Division maintains analysis certification in 43 states, 10 EPA Regions, the Center for Disease Control, and a private scientific society. The laboratory must maintain its certifications and follow approved analysis methodologies to meet environmental and occupational health requirements placed on Air Force installations worldwide. The major Air Force Commands at each installation have civil engineering, bioenvironmental engineering, and environmental management components that collect the required environmental and occupational health samples. They ship the majority of these samples to the Analytical Services Division for analysis. The installations use the analysis results to meet federal, state, and local requirements concerning pollution and health hazards. Failure to comply with all of the requirements could lead to mission interruptions, notices of violation, and fines up to \$25,000 per day per violation.

In the last several years, many factors have placed an increasing strain on the Analytical Services Division. As environmental and occupational health requirements grew more numerous and demanding, bases were forced to send more samples to the laboratory. The analysis requirements for each sample are growing more numerous and complex. Downsizing of the military has caused the laboratory to lose staff and face budget reductions. New requirements for certifications, sample holding times, decreased detection limits, and new reporting requirements were added each year. Dr Welch, Director of Armstrong Laboratory, had these concerns expressed to him by headquarter officials from our customer bases. He understood the problems faced by the laboratory and strongly supported us. However, he was concerned about possible laboratory failures and noncompliance situations at the bases and therefore requested the initiation on the PIT described in this application.

1.0 Teamwork

1.1 Team purpose and membership.

1.1.A. This application for the 1993 Air Force Team Quality Award describes and documents the activities of a Total Quality Process Improvement Team chartered by the Director of the 1,500 person Air Force Materiel Command, Human Systems Center, Armstrong Laboratory (AFMC/HSC/AL), Dr Billy E. Welch, and by the Chief of the Occupational and Environmental Health Directorate (AL/OE), Mr John C. Mitchell.

1.1.B. In response to customer feedback and the prospect of a greatly increasing work load, Dr Welch requested his total quality advisor, Dr Jim Cupello, to start a PIT in the Analytical Services Division (AL/OEA) for the general purpose of decreasing the time required to process analytical samples and report the results to the customer (turnaround time). To better define the PIT's purpose and establish selection criteria for team members, Dr Cupello designated an advance group consisting of himself, the Chief of OEA, two recently trained TQM Facilitators, and two statistical consultants. For two months, this advance group reviewed data on the 204,588 tests conducted by OEA during the previous 6 months, grouping the results by process step and analytical function. This preliminary analysis confirmed that turnaround time was indeed in need of improvement, and identified specific process steps (e.g., receipt of sample, analysis of sample, mailing results) and analytical functional areas (e.g., metals, inorganics, pesticides) that provided the greatest opportunities for improvement. The advance group met with Dr Welch and Mr Mitchell in Jul 92 and, after negotiations, a specific scope and set of goals for the team were established. (See Atch 1.1.B.)

1.1.C. During the Jul 92 meeting with Dr Welch and Mr Mitchell, the advance group proposed specific process steps and functional areas to be targeted for improvement, suggested the performance areas to be tracked and improved, proposed Team membership, recommended a 12-month effort, requested resource support in a number of areas, including professional team training and a dedicated TQ meeting room, requested permission to visit other analytical laboratories for benchmarking purposes, and asked for open access to the Director should problems arise. After discussion and negotiation, nearly all of the Team's proposals were accepted, with some modifications, resulting in mutual consensus among four levels of management.

1.1.D. The Team's charter (mission) aligned extremely well with HQ AFMC and HSC goals and supporting objectives. Most importantly, we were dedicated to meeting our customer's needs; our customers wanted quality analytical services with rapid turnaround time. Secondly, we were oriented toward operating quality installations by both improving the quality of our own organization and by providing speedy analysis of environmental samples, which effects the quality of all Air Force installations. Enabling people to excel is the very nature of the TQ approach to management. HQ AFMC Objective 1.3 is to be our customers' supplier of choice by meeting schedule baselines; the Team's mission was to reduce turnaround time so our customers could meet their schedules. HQ AFMC Objective 2.3 is to enable our people to excel through moving decisions to the lowest level, expanding individual responsibility and authority, and seeking feedback; the essence of the PIT was to empower members to question, challenge, and improve all analytical business practices. HQ AFMC Objective 4.1 and its HSC supporting objective is to enhance the competitiveness of our operations by improving throughput, decreasing inventory and operating expense, and streamlining support processes; it was obvious that the Team's mission of reducing turnaround time, while maintaining quality, was essential to our future as a support organization.

1.1.E. Individuals were afforded the opportunity to participate based on their expertise in the functional areas identified during the analysis by the advance group. Included were

both military and civilian representatives of varied ranks from each of the three targeted functional areas (Cortez, Cruz, Long), a representative of one of the lab's major customers (Garland), and individuals who were particularly familiar with laboratory automation and contracting (Schwartz, Wiley). Also included were individuals familiar with Division administrative and management issues (Jehl, D. Thompson, Thomas). The Team also included the two statisticians (Miller, Oakes) and two TQ facilitators (Engquist, Murphy) from the advance group, as well as administrative support to record minutes and track time during weekly meetings (I. Thompson). Final team membership was negotiated between the process owner and the advance group in Jul. After team training, the Team began work in Aug 92. (See Atch 1.1.E.)

1.2. Group Dynamics and Documentation

1.2.A. Smooth and effective team dynamics were greatly enhanced by a week of intensive on-site training on TQM PIT development that was conducted by professional TQM teachers from Change Navigators, Inc. of Loveland, CO. This training not only instructed the team on the use of numerous effective tools, but also instilled a sense of camaraderie. A particularly useful product that resulted from this training was our Code of Conduct, which later proved critical to our success as a team. This Code included such statements as "during team operations, all members will be considered equal, on a first name basis, regardless of rank", that "new ideas are expected", and that "ideas can be criticized, but not people". The Code was placed on the wall of the meeting room so any member could refer to it when necessary. Team dynamics were also helped by the presence of a facilitator at each meeting, however our Team learned to work so well together that the need for formal facilitation decreased steadily over the one year life of the Team.

1.2.B. The synergy generated by everyone's participation in the Team greatly facilitated the understanding of the laboratory processes and related problems. Since no one person was familiar with every aspect of the laboratory's functioning, there were always questions by some and answers by others, which led to an increased clarity of thought and to new ideas. This interaction led to fresh perspectives for area experts as well as created a better understanding for those who were not as familiar with a given area. For example, the use of Brainstorming and Affinity Diagrams allowed everyone to put forth their creative ideas and then, by clustering, expanding, and further discussion, arrive at truly team ideas and solutions that would not have occurred to any team member alone.

1.2.C. To ensure effective progress toward our purpose, a milestone chart was developed. The Team also followed the Armstrong Laboratory 14 Step Method for Continuous Improvement Manual as a guide for its development. Furthermore, agendas were provided prior to each meeting, thereby allowing members to come prepared and greatly increasing meeting efficiency and focus. (See Atch 1.2.C.)

1.2.D. Roles of our team members fell into six main categories. The facilitators kept the group focused on the TQ process and introduced and supervised our use of appropriate TQ tools. Members from target areas brought their specific expertise and experience to the group, and the customer member presented the AF user and base level perspective. The recorder was able to capture and record group ideas. The team leader provided the management perspective and our statisticians and computer programmers provided expert data analysis and perspective on automation. However, in addition to their main roles, all members contributed on all topics.

1.2.E. The Team documented its progress weekly through meeting critiques and detailed minutes. A storyboard was developed in the OEA work area and later placed in the

lobby of the AL command building so that others might follow the activities of the PIT. Furthermore, quarterly progress briefings were given to the Quality Council headed by Maj Gen Anderson, HSC.

2. Process Selection Criteria

2.1. The Team identified both external and internal customers. The external customers included all the AF-wide organizations that collect environmental and occupational samples and submit them to AL/OEA for analysis. We identified these customers through a historical address listing and found that 630 installations had submitted samples to OEA. We then grouped our customers into Bioenvironmental Engineers, Civil Engineers, other DoD groups, and Federal, State, and local regulatory agencies. Internal customers included other divisions in the OE directorate, which account for 10% of our analytical work. We also considered that in every process we evaluated, there were internal customers within the OEA division. For example, the chemists were customers of people who receive samples, and the data entry personnel were customers of the chemists. (See Atch 2.1.)

2.2. Identify the customer's key result areas (KRAs).

2.2.A. We used the expertise and experience of our customer team member and a prioritization matrix developed with senior MAJCOM customers to identify the customer's key result areas (KRAs). The Directorate sent a detailed questionnaire to key customers to determine KRAs as part of a separate activity in Nov 92. Then many of those customers met at Brooks AFB and completed a matrix of factors that, in part, described what they needed most from a support laboratory. Fifteen factors were ranked and weighted. These factors included accuracy and quality, rapid turnaround for special samples, chain-of-custody procedures, access to the status of samples, certification, etc. Further discussion and customer's comments led to a prioritization of customer desires. The Team's customer member provided further feedback at weekly meetings. A KRA of all analytical customers was fast turnaround time, and this was certainly the prime KRA on which a problem was perceived. Customer rankings dovetailed with the conclusions of the early data review by the advance group and customer comments we had received in the past. (See Atch 2.2.A.)

2.2.B. Our action, based on customer response, was to continue with the course of our charter to focus on reducing turnaround time and increasing capacity.

2.2.C. The Team's actions have had a direct impact on several of the customer's KRAs. We greatly improved turnaround time and capacity, as described in the results. The customers now has faster access to the status of their samples through early electronic mail. The spirit of change and customer focus, fostered by the Team, has resulted in spinoffs in more rapid customer service, improved handling of special samples, and increased laboratory automation.

2.3. Focus on customer satisfaction.

2.3.A. Prior to the start of the PIT, informal customer communication indicated that faster turnaround time was desired. At the Air Force-Wide Laboratory Consolidation Meeting, a survey was taken on customer satisfaction utilizing a Multivoting technique. A list of the top seven issues was generated in decreasing order of interest. Later, when the Team began to implement changes, customer satisfaction was assessed by requesting comments on initial electronic mail trials and consolidated results letters as well as issuing customer survey forms. (See Atch 2.3.A.)

2.3.B. Our initial conclusion was that to improve customer satisfaction, quicker turnaround times were needed. Later we concluded from the comments on the electronic mail trials that customers loved the immediate access to results.

2.3.C. The PIT adopted improvement in analysis turnaround time as its top priority. To keep the customers involved and to ensure effective feedback, communications with customers was given a high priority. The latest customer feedback was discussed at all PIT meetings. Based on the customer's comments on the electronic mail trials, we expanded the electronic mail database, and solicited other volunteers to use the program. Based on the positive feedback regarding the analytical results cover sheet, we have continued this procedure.

2.4. Process identification and definition.

2.4.A. Dr Cupello's advance group narrowed the scope of the PIT during its initial study of all processes and the overall performance of the laboratory. Flow Charts and Box and Whisker Diagrams were tools the Team used to identify processes and define boundaries. The Team used data from an extensive historical database. (See Atch 2.4.A.)

2.4.B. It was not difficult for the Team to determine if the boundaries of the process were within their scope. AL leadership empowered the Team to modify any applicable business practices. Those practices selected for process improvement fell functionally within the Analytical Services Division (OEA) and its Division Chief served as team leader. The functions on which the Team focused were showing high variability and long average analytical turnaround times.

2.5. Opportunities for improvement were identified and prioritized by a study of the historical data from our laboratory information system. From these data, the advance group identified four key areas for improvements: metal analysis, pesticide analysis, hazardous waste analysis, and customer service.

2.6. The Team evaluated process performance with metrics developed from the laboratory's historical data base. We produced Control Charts, Pareto Charts, and Scatter Diagrams to analyze turnaround time and sample workloads for each targeted area. (See Atch 2.6.)

2.7. A schedule for process documentation and leadership reviews.

2.7.A. The Team kept on schedule and provided leadership reviews by developing and maintaining milestones based on our charter. Facilitators followed the chart and kept us focused on the schedule. Review of progress often was made an agenda item. We provided senior leadership reviews through the storyboard and frequently briefed senior management.

2.7.B. Dr Welch and Mr Mitchell were briefed and gave approval to the original team charter. They also requested that HSC Quality Council be briefed quarterly, thereby keeping upper management informed on the Team's progress and providing an opportunity for feedback.

3. Analysis Techniques

3.1. Analyze the process for improvement.

3.1.A. Process analysis began with a general review of OEA procedures and functions, including a tour of the laboratory. Next, a very simple chart describing the flow of a sample through the lab was created. After narrowing the focus to three analytical functions,

additional tours were made. Brainstorming and Affinity techniques then were used to establish general process steps for Flow Charting, after which, a detailed Flow Chart was created for each of the three targeted analytical functions. (See Atch 3.1.A.)

3.1.B. Lab tours were especially important for Team members naïve to OEA, e.g., the facilitators and the customer representative. Their simple but probing questions often revealed process steps that were taken for granted by those who had been intimately involved with the process. The initial tour revealed six major process steps: shipping, log-in, analysis, reporting, verification, and mailing results. While the first and last two steps were similar for all samples, the analysis and verification steps were specific for each of eleven types of functional analyses (See previous Atch 2.4.A.). After the team decided to focus on only three of the eleven functions, detailed tours of each resulted in more questions and copious notes. Subsequent Brainstorming resulted in a broad process outline that was valid for the analysis and verification steps of any function. Team members representing specific functions were then asked to develop a detailed function-specific flowchart for their areas, using the broad outline devised by the team. These Flow Charts were presented to the team, critiqued, and revised. Brainstorming and Affinity Diagraming were used to help identify bottlenecks in problem areas.

3.2. Measurement of the process identified as relevant to customer needs/satisfaction.

3.2.A. Data on turnaround time for every analytical sample processed by OEA since 1991 were available to the Team in a laboratory information system (Hewlett Packard Lab/UX) computer database. While this database had been routinely maintained, it had never before been queried in the manner and detail required for Team use. Team members wrote programs to extract the desired data and TQM statistical process control software, developed by the Air Force Materiel Command, was used to generate Control Charts. Initial Control Charts, along with Box and Whisker summaries of the same data, were used to determine target function baselines. After narrowing the Team's scope, we developed specific Control Charts for each of the targeted functions and considered other factors, such as the day of the week a sample was received, the number of analyses required per sample, analytical equipment utilized, and volume of samples processed at the same time. (See Atch 3.2.A.)

3.2.B. Early in process analysis, we learned that some data fields in the database were automatically entered during certain operations whereas other fields were copied from forms and entered manually. It was easy to determine that the automatically recorded data were more complete and valid, so the Team limited its review to those data as much as possible. Furthermore, statistical analysis, as well as direct observation of our Control Charts and Box and Whisker Diagrams, revealed an inordinate number of outliers, which we were able to trace to consistent but inappropriate inclusion of certain types of data in our original analyses. These data were those from samples transshipped to contractors, samples generated by a special Environmental Protection Agency program, Quality Control samples, and canceled samples. We modified our programs accordingly, thereby obtaining much more valid, accurate, and relevant data for our process measurement of in-house analytical performance. The revised analyses still demonstrated a great opportunity for improvement in the targeted functions.

3.3. Problem identification

3.3.A. To facilitate problem and solution identification, the Team visited two premiere national analytical laboratories in Salt Lake City. The fresh ideas generated from this trip, along with the results of our own process identification and measurement, were used to Brainstorm and record as many candidate problem areas as possible. Then, using an Affinity Diagraming tool, problem areas were clustered and grouped into six primary categories,

which then made the major ribs of a Fishbone Diagram. Secondary and tertiary ribs were derived from the affinity groupings and supplemented by additional Brainstorming. (See Atch 3.3.A.; note that the Affinity Diagram was destroyed to make the original Fishbone Diagram and therefore couldn't be included.)

3.3.B. A two stage process was used to determine the most significant areas for improvement. First, using the extensive experience and expertise of the group, we labeled, by consensus, the various ribs of the Fishbone Diagram as having a large, medium, or small effect on turnaround time (See previous Atch 3.3.A.); eleven of the candidate problem areas were labeled as having a large influence. Next, we utilized the Interrelationship Digraph technique to pairwise rank these eleven factors in order to determine which were the driving or root causes. Of the five driving factors (those with the most "out" arrows on the digraph) two, New Regulations and Slow Procurement, were considered out of the Team's control. The three remaining, coordination, automation, and personnel experience, were thus identified as being the most significant improvement opportunities in our control. (See Atch 3.3.B.)

3.4. Throughout the whole procedure of process analysis, process measurement, and problem identification the Team's attention was constantly focused on the customer's most significant requirement, namely an improvement in turnaround time. The Team also was alert to the fact that other customer requirements, which were not perceived as a problem, could not be sacrificed to improve turnaround time. Customers were often asked for their comments on changes the Team were considering. During team meetings, the internal customer on the team helped keep our focus on customer requirements and became the leader for developing coordination alternatives with the customer.

3.5. The specific processes chosen for improvement were defined in the Flow Charts included earlier (See previous Atch 3.1.). The improvement approaches were identified as described above and further elaborated in Tree Diagrams utilized in delineating root causes (see Atch to later section, 3.6.A.) A letter was issued by the Division Chief to the Branch Chiefs to communicate the Team's decision. (See Atch 3.5.)

3.6 Root cause analysis.

3.6.A. Brainstorming, Multivoting, and Affinity Diagraming were used to develop Tree Diagrams to identify root causes and a range of possible solutions for each problem area. (See Atch 3.6.A.)

3.6.B. In order to verify root causes, appropriate team members developed check sheets, data forms, and survey tools to assess baseline times required for identified root causes. For example, customers were querieded on the time it took to receive mailed results, chemists recorded the time to complete manual calculations, and function managers recorded the time required to verify and sign reports.

3.7. After problem identification and the analysis of root causes, described earlier, final target selection was done using two approaches. First, we employed Criteria Development and Prioritization Matrix procedures, described more fully in section 4.2 (See Atch 4.3.) and second, we performed a risk/benefit analysis, which involved a variety of issues, including Division dynamics, and led to the exclusion of certain possible solutions from consideration.

4. Solutions

4.1. Possible solutions were identified simultaneously with root causes using Brainstorming, Multivoting, Affinity Diagrams, and Tree Diagrams (See previous Atch 3.6.A.). It was at this critical stage in Team activity that previous groundwork began to really pay off. The

original careful selection and training of team members, the cross functional education in OEA process of all members, our fact-finding tour of premiere national labs, the use of TQ teaming procedures, and the "just-in-time" introduction and use of TQ tools all contributed to a smoothly functioning group of experts that was optimally prepared for identifying and prioritizing possible solutions. Assistance and advice on possible solutions were also elicited from other experienced OEA personnel, who had not had the opportunity to participate in earlier Team activities.

4.2. In order to assess the best solutions, the Team first developed a set of implementation criteria and assigned weightings using a modified version of the Full Analytical Criteria Method. The original criteria were: low cost, low manpower, no effect on quality, not impeded by regulations, large reduction in turnaround time, high chance of success, high spin-off potential, and short time to implement. (After experience with the method, a number of criteria were later deleted.) Then, using a Prioritization Matrix technique, the various solutions developed using Tree Diagrams (See previous Atch 3.6.A.) were rated on each of the criteria. After being multiplied by the criteria weightings, the adjusted ranks were summed across criteria to yield a relative priority rating for each solution. From this matrix, the Team chose to implement solutions that had received the highest priority ratings.

4.3. After choosing target solutions, the Team broke into several subgroups to develop and implement specific action plans. Progress was reported and discussed at weekly meetings of the whole Team. Examples of three different action are provided. Also included are the final results from the prioritization matrices on which all actions plans were based. (See Atch 4.3.)

4.4. The Team tested all solutions on a small scale. For example, three appropriate Air Force bases were selected to test effects of sending analytical reports by electronic mail; results were sent by electronic mail for two months, and feedback was solicited from the customer. A similarly cautious test was conducted on the response to our changing the way analytical results are signed off by the chemist; we included a paragraph to the customer on the new version, explaining the change and soliciting comments and suggestions. We worked directly with our MAJCOM customers on how to better schedule sample workload, again explaining our proposals and soliciting feedback.

4.5. The Team ensured implementation of the action plans by including affected personnel, especially supervisory personnel and Branch Chiefs, in their development and execution. Often, affected personnel were invited to a weekly Team meeting at which a progress report on their area was on the agenda. Status of implementation was typically an agenda item on weekly meetings. Occasional briefings by Mr. Thomas to the OEA Division staff members also enlisted their support and helped ensure timely implementation.

5. Results

5.1. Results of the team's solutions met or exceeded customer requirements.

5.1.A Results derived from the Team's process improvement efforts fall into two main types. The first type relates to the effects of specific process changes that were expected to improve turnaround time. The results of these efforts are clearly successful. Because of changes in the procedures by which chemists sign-off on analytical results, this type of paper work has decreased from 57 to 74% in targeted areas. New electronic mailing procedures now provide results to the customer within 10 minutes of chemist approval, compared to 4-6 days required previously for postal delivery. In another case, implementation of new automated procedures has reduced by 50% the time required to download and quality control data.

The second type of result relates to improvements in overall turnaround time. While overall turnaround time for our targeted functions has decreased 30 to 36%, compared with

baseline performance, changes have been in place for far too short a time for these results to be conclusive. During the course of our examination of OEA processes, we learned that there are a great many factors affecting overall turnaround time, many of which are uncontrollable and somewhat unpredictable. For example, during the same time that turnaround times have declined, workload has increased by 30 to 38%, compared with the baseline period. Although we are optimistic that turnaround times will remain lower and decline even more, we feel we need at least six additional months of data to make an adequate assessment.

There also have been many positive spin-offs resulting from our improvements. The use of signature cover letters, electronic transfer of results, and automated downloading of analytical data has been adopted by four additional functions, not originally targeted by the Team. Increased automation has led to personal computers throughout the work area, speeding data handling and communications. Our introduction of daily and weekly sample management suspense lists allows chemists to identify and expedite older samples, reducing peaks in analysis turnaround times.

In the analytical services business, it is difficult to immediately measure whether our solutions meet or exceed the customer requirements. There are many variables that effect each sample, and while a customer will immediately notice if a single sample is very late, the same customer might be slow to realize that ten other samples have been analyzed 20 or 30% faster. However positive customer feedback on our initial steps, especially electronic mailing, show we are on the right track.

5.1.B. The results of specific process changes are easy to link directly to team efforts. The idea for having a single signature cover letter originated in the team and was researched and tested by the team prior to implementation; this prime example of finding and eliminating non-value added work, caused an immediate, significant time savings, clearly attributable to the Team. Similarly, the Team's introduction of electronic mailing of analytical results was logically developed using TQ tools, tested and revised, and then transitioned to the whole Division. This change saved days of turnaround time; the customers like it; and it would not have happened without the Team's efforts.

While the Team believes it has had a major impact on overall turnaround time, it is doubtful that such a global variable can ever be conclusively proven to have been caused exclusively or directly by the Team's changes. In an organization as complex and dynamic as OEA and with a metric as multidependent as turnaround time, it is impractical to conduct a controlled, scientific study. However, since the time-saving changes, described above, have shortened component parts of the overall turnaround process, we feel confident in extrapolating that our Team's efforts were, at least partially, responsible for the observed improvements in on overall turnaround time.

Phenomena such as enthusiasm, cooperation, and esprit de corps are difficult to measure, but we know that they affect the productivity of an organization and that they have dramatically increased in OEA over the past year. The Team would not presume to take credit for all of the attitudinal improvements in the Division, but can certainly attest to the positive effect participation in the PIT had on its own members.

5.2. The Team's results meet the HQ AFMC and HSC goals and objectives, earlier described with respect to Team mission (See previous section 1.1.D.). If our decreases in overall turnaround time are sustained, we will definitely have satisfied our customers' needs. Electronic reporting of results clearly supports our objective of helping customers' meet their schedules. Streamlining and automation of operations have greatly enhanced our business practices. The new esprit de corps and enthusiasm at all levels in the laboratory are indicators of success in enabling our people to excel. Our use of advanced automated technology has enhanced the technological superiority of our lab. Our improved ability to provide timely environmental analyses supports the operation of quality installations throughout the Air Force. We now have the capacity and excellence to attract and sustain new business. Our Team's results strongly support the goals and objectives of our organization.

6. Deployment

6.1. During preliminary testing and adjusting of the proposed process changes, Branch Chiefs and additional Function Chiefs from the areas most affected were invited to attend Team meetings. Their presence and involvement in the ensuing discussions proved extremely valuable to the implementation of the changes. After the concurrence of these leaders was secured, the Team scheduled briefings for the entire OEA division, at which proposed process changes were discussed in detail and comments were solicited. As the scheduled dates for implementation drew near, division personnel were updated via electronic mail. This approach allowed our introduction of an analytical report cover sheet and electronic mailing of results to expand from the initial test cases to becoming standardized procedures for the whole Division. To inform and involve the customer, the Team Leader visited several AF Command HQs and briefed key personnel on proposed improvements being considered by OEA. This information was also made available on the OE Directorate electronic bulletin board, to which over 240 of OEA's customer groups have access.

6.2. The Team believes that improvements in information availability and tracking, communication, and a new spirit of cooperation will ensure that the increased level of performance is maintained and shared. As a direct result of the Team's demands for data analysis and automation, information from the OEA database is much more readily available. The Team not only acquired workplace computers and developed software to automatically download data from analytical equipment, but also developed a maintenance procedure. Our programmer has followed up with the chemists to ensure the new output meets their needs, and will stay available to support changes. New, weekly metrics on turnaround time, workload, accuracy, productivity, backlog, and many other parameters are now available by analytical function to nearly all lab personnel. Regular tracking of such metrics is now required by management, ensuring that quality is maintained as turnaround time is decreased. Communication within OEA has improved considerably and, through a reorganized customer service area, communication with customers has never been better. Finally, our effective demonstration that empowerment and teamwork can lead to meaningful process improvements has resulted in a positive, energetic, and cooperative spirit in OEA that will ensure increased performance is maintained and shared well into the future.

6.3. As a result of the Team's recommendations, the OEA Division has implemented ongoing bench-level, process control, and management metrics to monitor results and ensure continuous process improvement. For management at the bench and Function Chief levels, the team instituted a daily "sample suspense list" and a weekly "sample suspense management list", for use in tracking sample turnaround time. These lists provide a detailed look at the status of all samples. Chemists can use them to control work flow and meet analysis times. Function Chiefs use the lists to manage personnel, schedule equipment maintenance, and decide when to augment in-house resources with contract laboratory capability. Branch and Function Chiefs now also receive weekly consolidated Control Charts on the customer's key interest areas, allowing them to assess trends and anticipate problem areas. (See Atch 6.3.)

7. Presentation

7.1. The primary tool we used for internal evaluation was that of holding a critique session at the end of each Team meeting. This critique involved the facilitator asking each Team member what that person liked best about the meeting and what that person would have improved. The responses were written down on a large tablet for all members to see and were included in the minutes of the meeting. Common complaints involved infractions of the Code of Conduct, concerns about losing focus or not making rapid enough progress, and the need for more resources. Sometimes the issues raised could be dealt with immediately, but

often they were included in the official agenda for the next meeting. Most of the time, the positive comments outweighed the negative and only minor corrections were needed to keep the Team on course. Initially, the Team facilitators held separate discussions with the Team leader to evaluate internal Team functioning. These discussions were helpful at the time but became unnecessary as the Team matured.

7.2 How did the team evaluate its performance externally?

7.2.A. The most severe problem faced by the Team was a drain on human resources. Midway through the Team's progress, two members were lost, one due to promotion/reassignment, and one due to unexpected retirement. The Team responded by adjusting the scope of the remaining work and by getting the temporary assistance of others with suitable expertise. Another human resource problem was the increasing demands on some of the Team members whose regular duties were in organizations other than OEA; this time the Team appealed to higher OE and AL leadership for a restoration of personnel resources and was at least partially successful. A third problem was that of obtaining adequate and timely physical resources, particularly computer hardware and software. As in other activities, the team took a combined "can do" and "make do" cooperative approach to get the job done. For example, one member might obtain a surplus computer, another the software, and another a peripheral device to create a needed system.

7.2.B. It is readily apparent that there have been many spin-offs and general benefits of our Team to the organization. Most important is the fact that our Team's success has demonstrated that there exists a willingness and a means for effective change in the organization. In these days of downsizing, yet increasing work load, it is easy to become discouraged and depressed. It is clear to OE and AL management, and to the Team itself, that its activities have increased spirits and reinstated confidence in all those involved in the endeavor. Another, more tangible benefit of the Team's existence was a great improvement in communication within the OEA Division and an increase in widespread understanding of Division processes. The invigorated OEA spirit and increased expertise were both demonstrated recently when a report of the AF Audit Agency required a complex and rapid response. Another benefit of the OEA Team's efforts to the broader organization has been the initiation of TQ teams in other OE Divisions by personnel who honed their skills on the OEA Team.

7.2.C. The OEA Team's most compelling communication tool was a 40 square foot, highly attractive, storyboard. After its initial development in the OEA work area, this dramatic display, which told the Team's story in easy to follow charts and illustrations, was placed for several months in the highly trafficked lobby of the AL command building. There it conveyed the message of an energetic TQ effort to employees throughout AL as well as to many visitors from other organizations. The Team also used briefings and publications to share its experiences with others. At various times during the year, the team leader, Mr Thomas, formally briefed AL, OE, and HSC senior management, the HSC Quality Council, all employees in the OEA Division, specialized audiences in the OE Directorate, and MAJCOM headquarters. The activities of the Team were discussed in AL's Quality Air Force Newsletter, and the Brooks AFB newspaper. Customers were advised of Team actions through an article in the OE newsletter, which is distributed AF-wide to civil engineer and medical customers, and by adding a paragraph to our sample results sheets, which go directly to the technicians in the field. Finally, Team benefits and lessons learned were spread verbally to others directly by each Team member; in three clear cases, team members used expertise and experience gained on the OEA team to benefit TQ activities in other organizations. (See Atch 7.2.C.)

ATTACHMENTS

ATTACHMENT 1.1B - TEAM PURPOSE

Mission Statement
Scope of PIT Group
Administrative Issues
Empowerment Issues
Code of Conduct

ATTACHMENT 1.1E - PIT MEMBERSHIP

Membership Selection Criteria
Laboratory Staffing Diagram
Team Membership

ATTACHMENT 1.2C - TIME MANAGEMENT AND GUIDELINES

Meeting Agenda Example
PIT Group Milestone Chart
Continuous Process Improvement Guide

ATTACHMENT 2.1 - CUSTOMER IDENTIFICATION

Analytical Services Customers
FY92 Customers by Command

ATTACHMENT 2.2A - TOOLS USED TO SURVEY CUSTOMERS

Environmental Sample Analysis Questionnaire

ATTACHMENT 2.3A - CUSTOMER SATISFACTION DATA

Key Parameters of Customer Satisfaction

ATTACHMENT 2.4A - FLOW CHART AND STUDY OF ANALYTICAL CHEMISTRY PROCESSING STEPS IN THE LABORATORY

Process Flow Chart
Codes for Analysis Functions
Box/Whisker Diagram for Process
Box/Whisker Diagrams for Analysis Times

ATTACHMENT 2.6 - EVALUATION OF PROCESS PERFORMANCE

Samples Received Control Charts
In-house
Total
Analysis Times Control Charts
Metals
Pesticides
Scatter Diagrams
Pareto Chart

ATTACHMENT 3.1A - TOOLS USED TO ANALYZE THE PROCESS

Metals Analysis Flow Chart (condensed)
Raw Chart
Customer Services Flow Chart (condensed)
Pesticide Analysis Flow Chart
Sample Process Flow Chart

ATTACHMENT 3.2A - PROCESS PERFORMANCE BASELINE

Control Charts:
Metals(01)-1991
Metals(01)-1992
Pesticides(04)-1991
Pesticides(04)-1992
Samples Received

ATTACHMENT 3.3A - IDENTIFICATION OF POTENTIAL AREAS FOR PROCESS IMPROVEMENT

Metals Analysis Fishbone Diagram
Laboratories Visit Findings

ATTACHMENT 3.3B - DETERMINATION OF MOST SIGNIFICANT IMPROVEMENT OPPORTUNITIES

Interrelationship Digraph

ATTACHMENT 3.5 - FINAL STATEMENT OF THE PROCESS TO BE IMPROVED

Division Chief Letter

ATTACHMENT 3.6A - TOOLS USED IN ROOT CAUSE ANALYSIS

Tree Diagrams:
Improve Automation
Work Flow Management
Personnel Experience

ATTACHMENT 4.3 - TEAM ACTION PLANS

Direct Data Transfer Plan
Electronic Result Mailing Plan
Coversheet Plan
Matrix Diagram - Work Flow Management
Root Cause Ratings:
Improve Automation
Work Flow Management
Personnel Experience

**ATTACHMENT 6.3 - METRICS USED ON AN ON-GOING BASIS TO ENSURE
CONTINUOUS PROCESS IMPROVEMENT**

Performance Charts

Sample Suspense List

Sample Suspense Management List

**ATTACHMENT 7.2C - BENEFITS OF THE TEAM AND LESSON LEARNED THAT WERE
COMMUNICATED**

Storyboard Photo

AL Newsletter Article

OE Newsletter Article

Customer Satisfaction Survey

Customer Feedback Electronic Mailing

Cover Letter Explanation

Attachment 1.1B - Team Purpose

When Prepared: August 1992

Need/Purpose: Mission Statement and Scope - Direction
for Team

Administrative Issues - Guidelines for Team

Empowerment Issues - Support by
Management

Code of Conduct - Rules for Team

How: Mission Statement and Scope - Developed by Team in
Brainstorming/Sessions

Administrative, Empowerment Issues - Developed by
Mr Thomas, Dr Cupello and agreed
upon by Dr Billy Welch, AL/CC

Code of Conduct - Developed by Team during Team
Training Process



TEAM MISSION STATEMENT

- **FOR METALS, PESTICIDES AND CUSTOMER SERVICES FUNCTIONS, REDUCE THE AVERAGE PROCESSING TIMES AND INTRA-FUNCTION VARIATION ASSOCIATED WITH THOSE PROCESSING TIMES.**
- **FOR METALS AND PESTICIDE FUNCTIONS, INCREASE LAB TESTING CAPABILITIES BY IMPROVING THE OEA PROCESSING STEPS BETWEEN "ANALYSIS" AND "REPORTING OF RESULTS" WITHOUT COMPROMISING QUALITY.**
- **PROVIDE CUSTOMER SERVICE AND PERFORMANCE DATA TO OE MANAGEMENT AND ASSIST IN THE DEVELOPMENT OF MARKETING MATERIALS.**



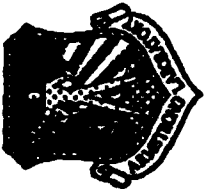
SCOPE OF PIT GROUP

- **ONE YEAR COMMITMENT BY TEAM**
- **WILL IDENTIFY PROBLEMS IN THREE FUNCTIONS**
- **WILL ZERO IN ON ONE OR TWO MAJOR PROBLEMS IN EACH FUNCTION**
- **SCHEDULE:**

FIRST 6 MONTHS: IDENTIFY MAJOR PROBLEMS AND ESTABLISH BASELINES

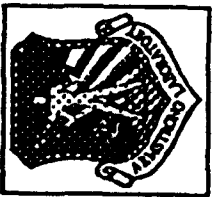
NEXT 3 MONTHS: FIND POSSIBLE FIXES FOR PROBLEMS AND IMPLEMENT

FINAL 3 MONTHS: TRACK FIXES AND SHOW IMPROVEMENTS



ADMINISTRATIVE ISSUES

- OEA OUTPUT IN THESE 5 FUNCTIONS WILL LIKELY DECLINE DURING THIS TEAM ACTIVITY
- TEAM MEMBERSHIP WILL BE BY INVITATION
- THE TEAM WILL MEET 90 MINUTES/WEEK (1530-1700 HRS)
- TEAM MINUTES WILL BE TAKEN BY A DEPARTMENT SECRETARY; NON-TEAM MEMBER
- QUALITY COUNCIL WILL BE BRIEFED AT LEAST QUARTERLY; MORE FREQUENTLY AT FIRST
- TEAM LEADER IS MR THOMAS C. THOMAS
- TEAM WILL NOT UNDERTAKE ANY PROCESS IMPROVEMENTS THAT CANNOT BE FULLY IMPLEMENTED DURING THE 9-12 MONTH DURATION OF THE TEAM
- IN THE EVENT ANY ISSUES ARISE THAT CANNOT BE RESOLVED BETWEEN THE TEAM LEADER (MR THOMAS) AND THE FACILITATOR (MR CUPELLO), THOSE ISSUES WILL BE BROUGHT TO THE ATTENTION OF THE QUALITY COUNCIL FOR RESOLUTION
- THIS TEAM IS "LIKELY" TO EXIST FOR A PERIOD OF UP TO 12 MONTHS



"EMPOWERMENT ISSUES"

- SERIOUS CONSIDERATION SHOULD BE GIVEN TO SENDING SELECT TEAM MEMBERS TO VISIT AT LEAST ONE OTHER "QUALITY" ENVIRONMENT TESTING LAB IN THE COUNTRY; PHILOSOPHICALLY DOES THE QUALITY COUNCIL SEE THE MERIT OF SUCH A SITE VISIT?
- THERE SHOULD BE AT LEAST ONE EXTERNAL CUSTOMER ON THE TEAM
- THE TEAM SHOULD HAVE PERMISSION TO CONDUCT A SURVEY OF CUSTOMERS IF THEY DEEM IT NECESSARY
- ALL TEAM MEMBERS WILL BE TRAINED IN GROUP DYNAMICS, TEAM ACTIVITY, ETC. BY CHANGE NAVIGATORS; AND OTHER ORGANIZATIONS IF NECESSARY
- TEAM PROGRESS WILL BE DISPLAYED PUBLICLY ON A "STORYBOARD" IN THE LOBBY OF BLDG. 125
- THE TEAM WILL HAVE ACCESS TO THE ENTIRE LAB/UX DATABASE, WILL TREAT ALL SUCH DATA AS PROPRIETARY AND SENSITIVE, AND WILL RETURN OR DESTROY ALL MATERIALS RECEIVED ONCE IT IS NO LONGER OF VALUE TO THE TEAM
- THE TEAM WILL ASSUME THAT THERE ARE NO "SACRED COWS"; ANY AND ALL PROCESS IMPROVEMENT IDEAS ARE FAIR GAME AND OPEN FOR DISCUSSION
- DUE TO MAGNITUDE OF THE OEA DATABASE THE TEAM WILL BE PROVIDED WITH THE REQUISITE DATA PROCESSING AND STATISTICAL ANALYSIS SUPPORT IT DEEMS NECESSARY TO CARRY ITS ASSIGNMENT



RULES AGREED UPON BY TEAM

- ***EQUALITY OF MEMBERS, FIRST NAME BASIS***
- ***ATTACK PROBLEMS NOT IDEAS***
- ***ENCOURAGE NEW AND INNOVATIVE IDEAS***
- ***NO GROUP DIVISIONS***
- ***TOTAL PARTICIPATION BY EACH MEMBER***



- **COME PREPARED**
- **REGULAR MEETING TIMES**
- **NO PRE-CONCEIVED NOTIONS**
- **NO SACRED COWS**
- **CONSIDER CUSTOMERS**
- **BE ON-TIME, END ON-TIME**

Attachment 1.1E - PIT MEMBERSHIP

When Prepared: July 1992

Need/Purpose: To select an effective team

How: Membership Selection Criteria - Developed by Mr Thomas and Dr Cupello to determine team membership.

Laboratory Staffing Diagram - Used by Mr Thomas to select members ensuring laboratory-wide representation.

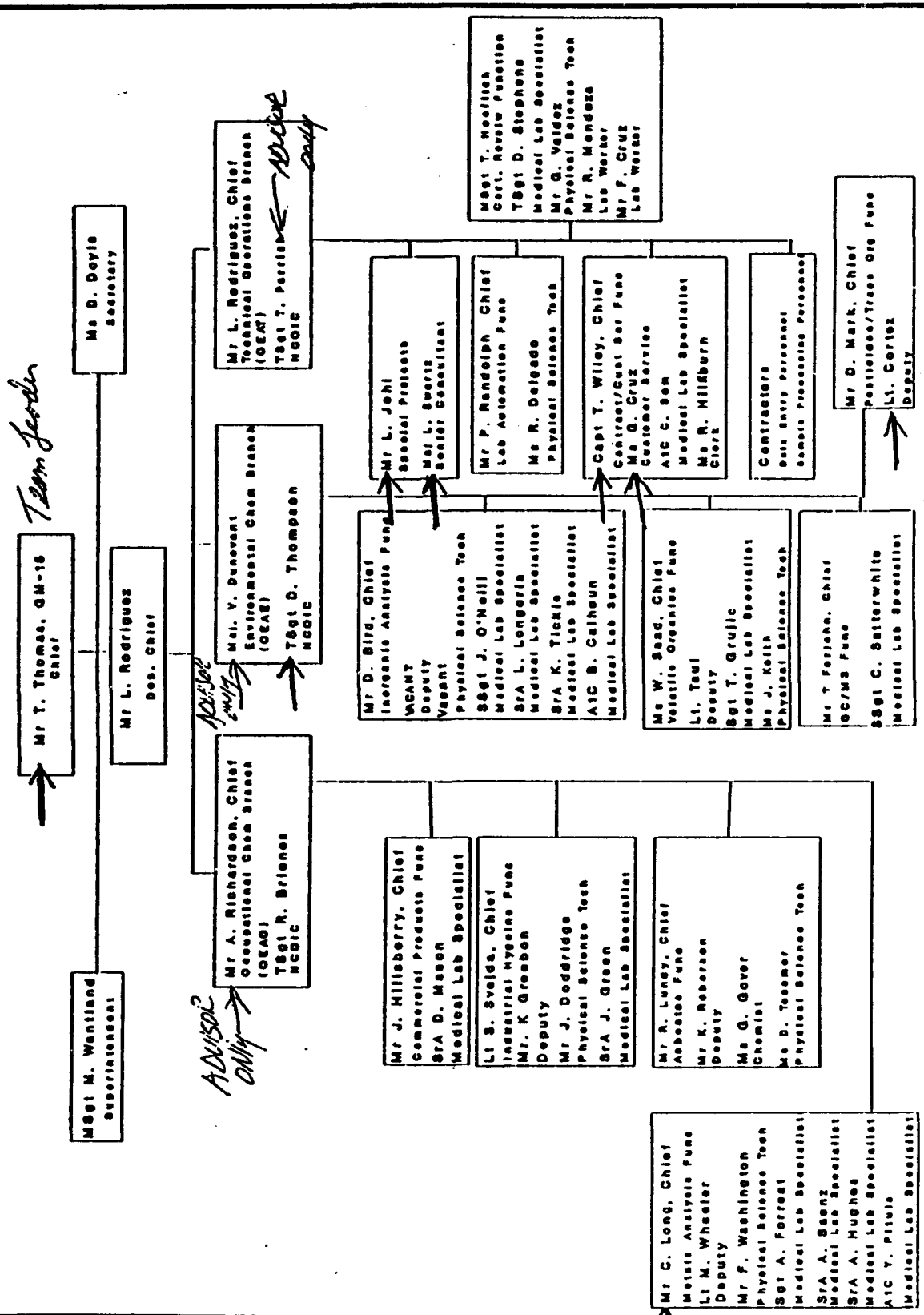
Team Members Chart - Final team selection

MEMBERSHIP SELECTION CRITERIA

- VOLUNTEER TO DEDICATE THEMSELVES TO A ONE YEAR PROJECT INVOLVING WEEKLY MEETINGS
- PERSONNEL FROM IN-HOUSE, CUSTOMER, AND SUPPORT AREAS
- MUST BE WILLING TO ATTEND A ONE WEEK TRAINING COURSE PROVIDED BY CHANGE NAVIGATORS FROM DENVER COLORADO
- WILLING TO ACCEPT THIS ADDITIONAL WORKLOAD AND MAINTAIN THEIR NORMAL WORK ASSIGNMENTS
- DIVERSE MEMBERSHIP
 - REPRESENTATIVE RANK STRUCTURE
 - PERSONNEL WITH A WIDE RANGE OF EXPERTISE
 - INDIVIDUALS THAT DON'T HAVE THE MIND-SET "THAT IS THE WAY IT'S ALWAYS BEEN DONE"

T.C.T. 15 July 92

ARMSTRONG LABORATORY
Analytical Services Division (OEA)



also. Tsgt I. Thompson - OEF, welcome; Lt Col John Varland A1/DEBB
Suggest: Ernie Baker, A1/SLP, AKEE member?

<u>Name</u>	<u>Duty Title</u>	<u>Office Symbol</u>	<u>Team Function</u>
2Lt Chris Cortez	Deputy, Trace Organics	AL/OEAE	Trace Organics
Ms Lupe Cruz, GS5	Chief, Customer Service	AL/OEAT	Customer Service
Dr Jim Cupello, GM15	Total Quality Advisor	AL/TQ	Total Quality Advisor
Capt Sheree Engquist	Chief, Person Job Match Technology	AL/HRLM	Facilitator
Maj John Garland	Chief, Water Quality	AL/OEBE	Customer
Mr Leo Jehl, GS13	Chief, Special Projects	AL/OEAT	Asst Team Chief
Mr Cornell Long, GS12	Chief, Metals Analysis	AL/OEAE	Metals
Ms Stephanie Miller, GS9	Research Physiologist	AL/OERP	Statistician
Dr Michael Murphy, GM14	Chief, Performance Extrapolation	AL/OERP	Facilitator
Mr Ernie Oakes, GS12	Lead Programmer	AL/OEYSCP	Statistician
Maj Lloyd Swartz	Chief Consultant, Lab Automation	AL.OEAT	Lab Automation
Mr Thomas Thomas, GM15	Chief, Analytical Division	AL/OEA	Team Leader
TSgt Dan Thompson	NCOIC, Environmental Chemistry	AL/OEAE	Environmental Chemistry
SSgt Ira Thompson	NCOIC, Quality Assurance	AL/OEPQ	Recorder
Capt Tim Wiley	Chief, Contracting and Cust. Service	AL/OEAT	Contracting Services

Attachment 1.2C - Time Management and Guidelines

When Prepared: Meeting Agenda: 13 October 1992
Milestone Chart: August 1992
CPI: Early 1992

Need/Purpose: To ensure the team stayed on the original timeline and meet the steps necessary to to identify and improve problems.

How: Meeting Agenda - Developed by group participation at end of each meeting. Agenda was set for next meeting.

Milestone Chart - Developed by Team Leader

CPI - 14 Step method for PIT groups to use.
Developed by Dr Cupello for use by Armstrong Laboratory PIT groups.

Meeting Agenda

There will be a meeting in Bldg. 140,
 Room Conf. R. on 13 Oct 92 (date)
 Purpose: PIT Group Meeting
 Called by: T. Thomas
 Start time: 0930
 Ending time: 1100

Participants:	
Dr Cupeillo (AL/TU)	2Lt Cortez
Dr Murphy (OED)	Major Swartz
Capt Enquist (HRLM)	TSgt D. Thompson
Ms Cruz	SSgt I. Thompson
Mr Jehl	Capt VHeey
Mr E. Oakes (SCYOEP)	Mr Long
Major Garland (OEDE)	
Ms S. Miller (OED)	
cc:	

Item #	Description of Agenda Item	Responsible Person	Desired Outcome(s)	Time Allotted	Process to be used
1.	Flow Chart Presentation of Hazardous Waste Analyses	L. Jehl	Understand Process	0930-0945	Blackboard, Over-head Viewer
2.	Flow Chart Presentation of Pesticide Analyses	Lt Cortez	Understand Process	0945-1000	Blackboard, Over-head Viewer
3.	Flow Chart Presentation of Metal Analyses	C. Long	Understand Process	1000-1015	Blackboard, Over-head Viewer
4.	Flow Chart Presentation of Customer Service	L. Cruz	Understand Process	1015-1030	Blackboard, Over-head Viewer
5.	Discussion on Agenda-What Area of Flow Charting to Focus in on?	L. Jehl	Follow on Study Area	1030-1045	Group Discussion
6.	Other Items/Critique	Dr Cupeillo	Better Meetings	1045-1100	Group Involvement

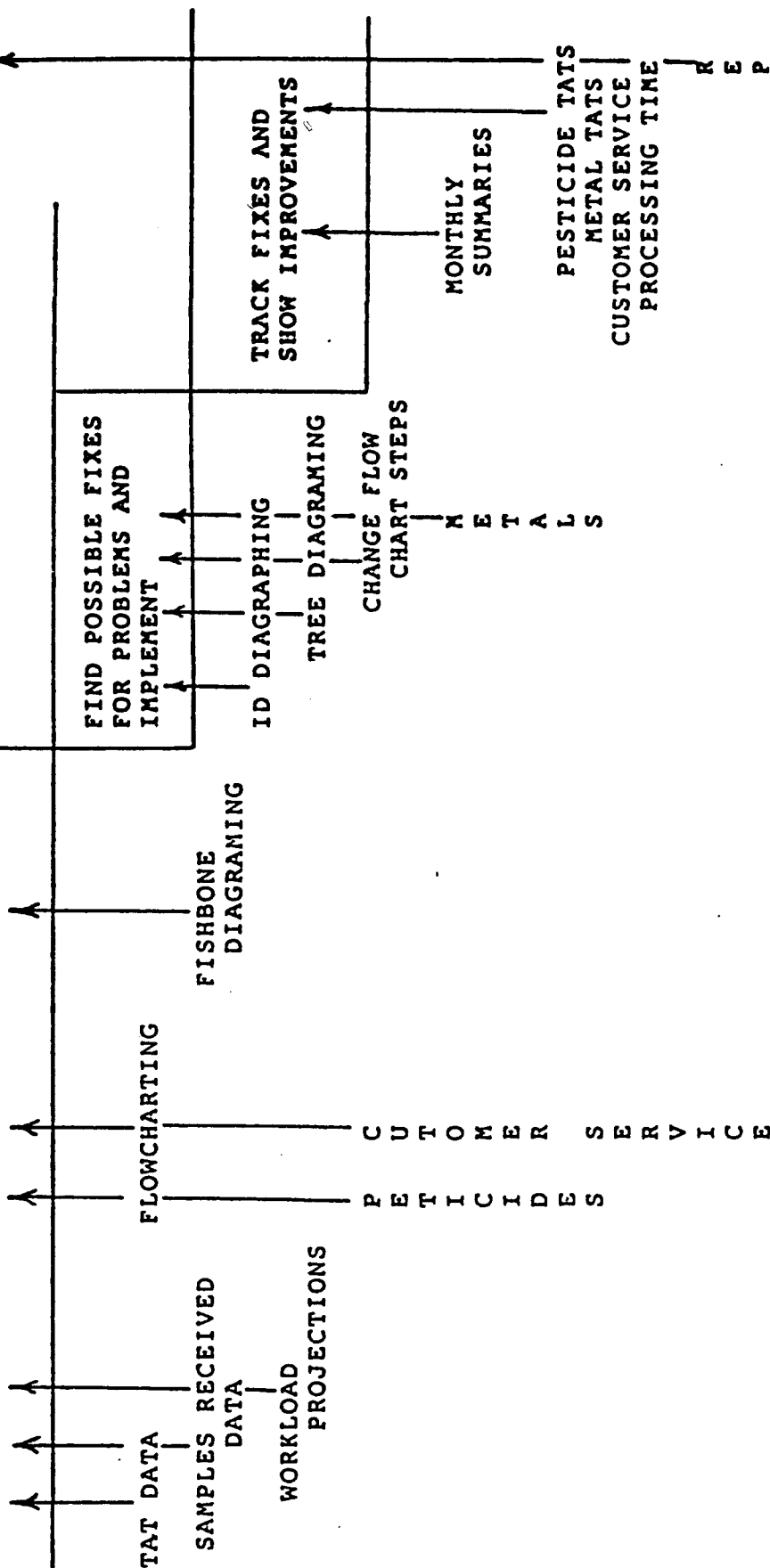
*All good meetings eventually degenerate into work. (Peter Drucker)

AL70120417

MILESTONE CHART FOR AL/OEA PIT GROUP

AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG

IDENTIFY MAJOR PROBLEMS & ESTABLISH BASELINES



AL/OE
CC

C



I

14 Step Method For Continuous Process Improvement

The Armstrong Laboratory 14 Step Method For Continuous Process Improvement (CPI)

by
Dr. James M. Cupello

**Copyright 1992
Armstrong Laboratory
Human Systems Center
Air Force Materiel Command
Brooks Air Force Base, Texas 78235
(512)-536-2091 DSN 240-2091**

The Armstrong Laboratory 14 Step Method For Continuous Process Improvement (CPI)

There are literally dozens, if not hundreds, of process improvement recipes used by various companies, government agencies, total quality gurus, etc. In developing this employee handbook we looked at a number of them.

For example, Dow Chemical Company describes a 10-step method in their employee **QUALITY PERFORMANCE GUIDEBOOK**. Lockheed Corporation publishes a 5-step process in their **GUIDELINES AND TOOLS FOR CONTINUOUS IMPROVEMENT** booklet. Joiner Associates Inc. publishes a copyrighted booklet entitled the **JOINER 7 STEP METHOD**. The Xerox Corporation U.S. Marketing Group employs a 9-step quality improvement process in their **USMG PARTNERSHIP** booklet. Mr. Hitoshi Kume, 1989 winner of the Deming Prize for individual achievement describes a 7-step process in Chapter 10 of his 1985 book entitled **STATISTICAL METHODS FOR QUALITY IMPROVEMENT**. The Japanese Union of Scientists and Engineers (JUSE) Problem Solving Research Group recommends a 14-step process. Electronic Systems Center and the Rome Laboratory, our sister DOD laboratory, employ a 7-step model when training their process improvement teams. Lam, Watson and Schmidt offer a 14-step and 9-step methodology in their 1991 textbook entitled **TOTAL QUALITY**. Peter Scholtes, in the highly acclaimed **TEAM HANDBOOK**, describes a 5-step method. Boeing Aerospace Company teaches a 9-step problem-solving process in their **TOTAL QUALITY IMPROVEMENT** guide. I won't bore you with any more examples, but there are plenty of them.

Quality gurus the world over would be the first to admit that at the heart of each of these methods listed above is the basic Shewhart Cycle, also known as the 4-step PDCA (Plan, Do, Check, Act) Cycle or Deming Cycle. So why not just use the simpler 4-step PDCA cycle? The more detailed, 14-step method described here provides a useful framework for most people who are just beginning to become involved in process improvement. In this author's experience a 4-step process lacks sufficient detail and guidance to help the beginner. On the other hand, most experienced practitioners do not find a more detailed methodology to be a burden; successful teams end up following the same general pattern irrespective of the model chosen. So the 14-step process has been selected because of its utility to both "new" and "seasoned" practitioners alike.

Lastly, we recommend that you start small with your process improvement efforts. Pick a problem or process within your group's total control; ensure you can identify customers, as well as your product or service, very clearly; and pick a problem you can solve in 3-9 months, including the time it takes to charter, form and train a small, functional team.

Initially follow the process outlined here as closely as possible. Use it as a crutch until you have the experience to customize it to each situation. But most of all, enjoy the challenge of continuous improvement. It will be the hardest, and most enjoyable, work you will ever do.

14. Anticipate and plan
future improvements

13. Celebrate team success !!!

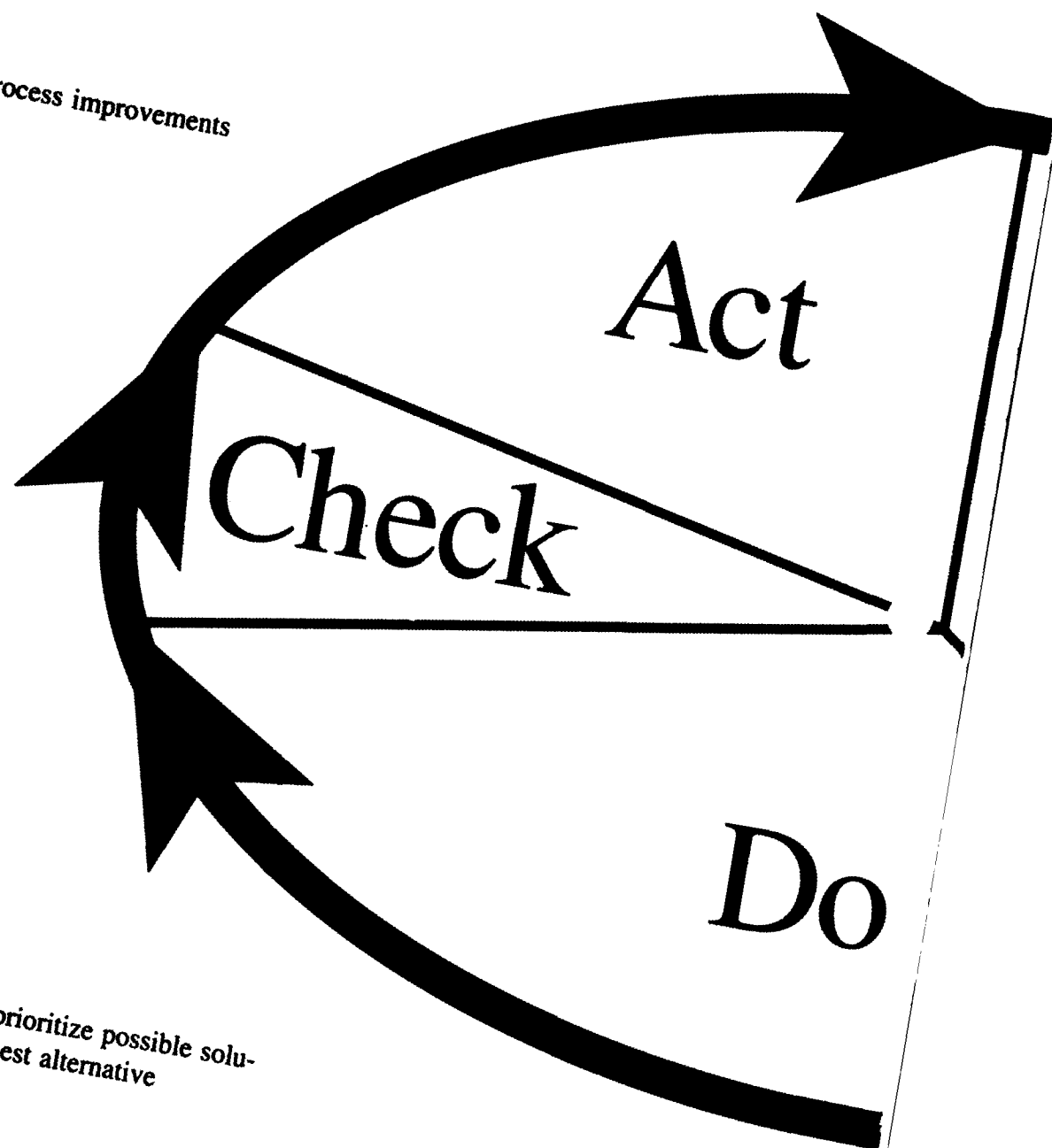
12. Standardize the process improvements

11. Evaluate and confirm
improvement to the process

10. Develop and implement
solution(s) on a small scale

9. Identify and prioritize possible solu-
tions; select the best alternative

8. Verify root causes of the problem
with data



1. Identify, prioritize and select opportunities for improvement

2. Identify the customer(s) of primary concern and the product or service targeted for improvement

3. Select team members; develop a Team "mission statement;" negotiate a Team Charter with the Quality Council

Plan



4. Describe specific characteristics of the problem from as many perspectives as possible

5. Identify the process that is producing the troublesome symptoms and describe this process in detail

6. Identify key parameters for measuring customer satisfaction; establish targets for improvement whenever possible

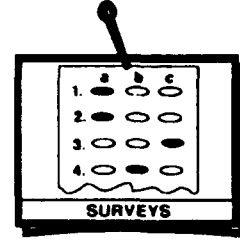
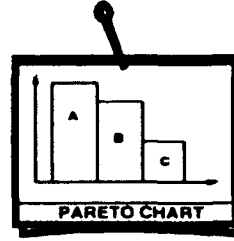
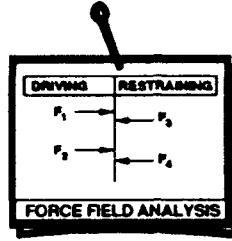
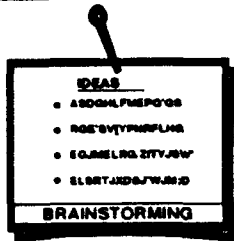
Identify the probably causes of, barriers to, process improvement

1

Identify, prioritize, and select opportunities for improvement.

Hints	Example
<i>What issues do external customers bring to the attention of senior management most frequently?</i>	<p>There are problems everywhere, both large and small. With limited time, money and people resources, only the most important problems should be addressed. One of the key roles of senior management is to prioritize what gets done. In a TQL environment, this means the Quality Council selects and charters all process improvement activity. They should know better than anyone the major concerns of external customers.</p> <p>The fictitious example to be used throughout this booklet involves the following concern, expressed by the head of the Quality Council.</p>
<i>Which new products and services do your customers keep "bugging" you to provide?</i>	<p>"In the current DOD environment of base closures and force reductions, it is likely that this Laboratory will have to significantly increase its capacity to do drug testing for DOD personnel. How can we increase the number of samples we process per month?"</p>
<i>When angry customers complain to senior leadership, what is it they complain about most vehemently or most often?</i>	<p>CAUTION: Executives tend to identify large system problems like: "Solve world hunger!" System problems are generally too complex to attack whole. They need to be broken down into their smaller components called processes, and improved one process at a time. By definition then, your team is likely to end up working on a problem slightly different than originally identified by the Quality Council. You need to manage the Council's expectations in this regard very carefully.</p>

Useful Tools



Hints

Notes & Data

What issues do "AL" executives consistently identify as major barriers to satisfying the external customer?

If you called one of your external customers and described the "team" project you had selected as a continuous improvement project, would he/she tell you to pick a better one?

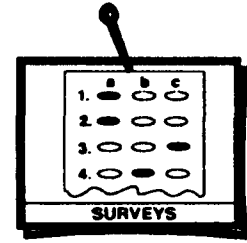
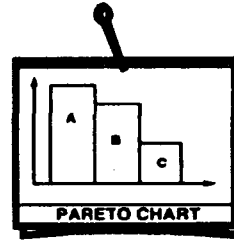
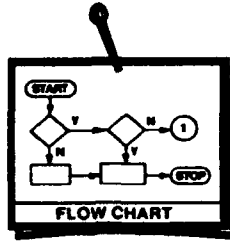
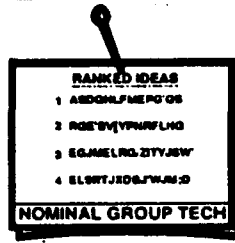
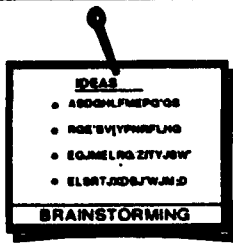
What issues do middle managers identify as the "really" big ones that executives always overlook?

2

Identify the customer(s) of primary concern and the product or service targeted for improvement.

Hints	Example
<p>List all external customers currently using the system or process identified in Step 1. Be specific.</p>	<p>The process owner described the "AL" drug testing system as shown below. Please note that it consists of a number of processes.</p> <pre> graph LR A((1-7 Days)) --> B((2-8 Hrs)) B --> C((4-8 Hrs)) C --> D((2-4 Hrs)) D --> E((8-12 Hrs)) E --> F((8 Hr-10 Days)) F --> G((3-7 Days)) G --> H((7-20 Days Total)) </pre> <p>NOTE: The last two process steps seem to offer the greatest potential for "reducing cycle time." But remember, the Quality Council defined the problem in terms of "samples/month."</p> <p>The only external customers are the Air Force and Marines at 15,000 and 5,000 samples per month, respectively. Monthly workloads range from 17,000-25,000 samples. Two Marine bases account for 80% of Marine samples. Over 100 Air Force installations submit samples to the Laboratory.</p> <p>CAUTION: There is a tendency at this stage to try and define/solve the problem. But we are still attempting to identify the process we are going to propose to the Quality Council for improvement. Focus on process, not problem.</p>
<p>What does each of these customers expect in the way of products/services? Do all customers expect exactly the same "thing?"</p>	
<p>Describe the process used to deliver this product/service using a flow chart with no more than 5-10 process steps; macro-flow charting, if you will.</p>	

Useful Tools



Hints

Who is the process owner for this process? Did you involve him/her in this step?

Who on the Quality Council does the process owner ultimately report to? If no one, you have a serious problem.

Consider which external customer you might invite to "sit" on your process improvement team.

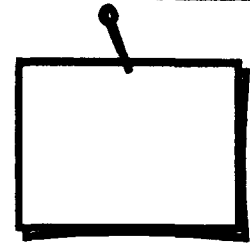
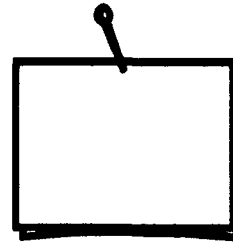
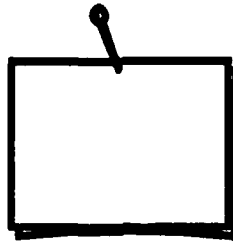
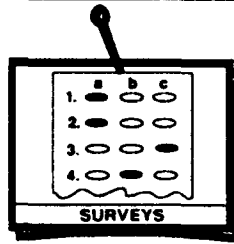
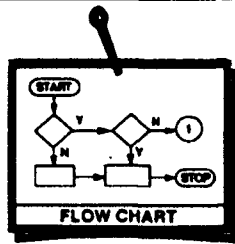
Notes & Data

3

Select team members; develop a Team "mission statement;" negotiate and develop a Team Charter with the Quality Council.

Hints	Example
<p><i>Based on what you discovered in Step 2, who should be on the team? Will you attempt to improve all of the steps on the macro-flow chart, or will you focus on those few steps with the greatest potential for improvement?</i></p> <p><i>Are the supervisors of potential team members aware that this process is under review? Do they understand that senior management is sponsoring the effort?</i></p> <p><i>Do team members have time to spend 1-2 hours per week in team activity? How will they get their other work done? Note: this team could function for 6-12 months.</i></p>	<p>Lets assume that the Quality Council, appropriate Director and process owner all agree to focus on the last two steps identified on the "macro" flow chart. How are team members identified? Simply stated, the process owner must map the process to a finer level of detail, and in so doing identify key players in the process. The people who do the work are the best qualified to improve the process, if they are trained and empowered.</p> <p>The diagram illustrates the preparation of AF Form 1890 and the assignment of team members across three branches. At the top, a curved arrow labeled "Prepare AF Form 1890" points to "Team Leader: John". To the right, a straight arrow labeled "AF Form 1890 Received" points to "Facilitator: Jim". Below these, three boxes represent Branch A, Branch B, and Branch C. Branch A contains a flowchart with a circle, a square, and a diamond, with the names "Lea" and "Thanos" below. Branch B contains a flowchart with a circle, a diamond, and a circle, with the names "Michael" and "Frank" below. Branch C contains a flowchart with a circle, a diamond, and a circle, with the names "Sheree" and "Eddie" below. Arrows connect the flowcharts across the branches, indicating a process flow.</p> <p>CAUTION: The team should be kept small (5-10 people). Team members need training in group dynamics and quality tools before being asked to negotiate a team charter with the Quality Council. Quality takes time.</p>

Useful Tools



Hints

Notes & Data

Does the process owner know the detailed process well enough to recommend team members? If not, find someone who can.

Which members of the Quality Council are stakeholders of the process to be improved? What restrictions or limits might they place on your improvement efforts? Why?

Which team members will negotiate the team charter with the Quality Council? Why not all of them? When? Where? How long will it take? How polished should it be?

4

Describe specific characteristics of the "improvement opportunity" from as many perspectives as possible.

Hints

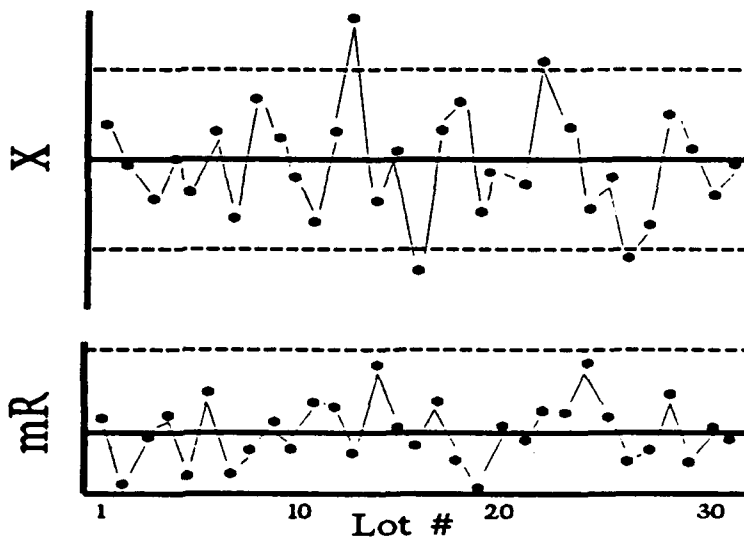
Historically, what kind of performance has this process been able to deliver? Plot the data on a run chart or control chart.

From a time perspective, does process variation change from morning to afternoon, day to day, week to week, month to month, seasonally, etc?

From a location perspective, does process variation change with different suppliers, how and where product is stored, how product is shipped to the customer, geographic location of the customer, which machines are used to produce it, etc?

Example

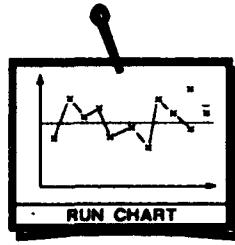
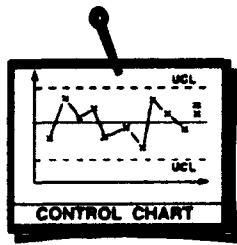
"Skilled original investigators and private detectives always use a common technique: they thoroughly investigate the site of the crime before they do anything else. They obtain clues from the site on which to base their hunt for the perpetrator, and gradually tighten the noose around the suspect. If the investigator does not thoroughly appreciate the situation where the crime was committed before starting the search, he will not only fail to find the right person, but may wind up arresting a wholly innocent person. The same is true in problem solving." [Hitoshi Kume in STATISTICAL METHODS FOR QUALITY IMPROVEMENT, 1985.]



XmR Chart For Drug Testing Cycle Time

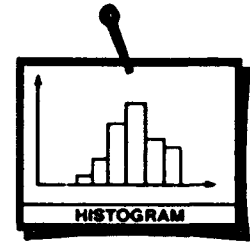
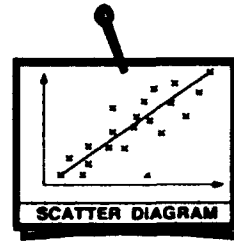
CAUTION: The objective of this step is not to discover the causes of the problem in question, but to understand the environment in which the causes have been able to survive and flourish.

Useful Tools



DEFECT	1	2	Σ
A	10	1	11
B	111	1	12
TOTAL	21	2	23

CHECK SHEET



Hints

Spend time at the process location and collect information that cannot be put into data form.

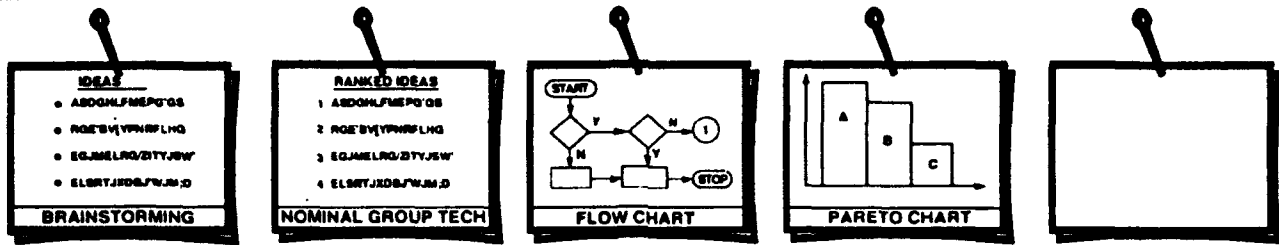
From a symptoms perspective, how do "defects" reveal themselves: schedule, cost, appearance, functionality, accuracy, etc?

When the process is working poorly or producing poor results, who is involved in the process and who is not?

Notes & Data

Identify the process that is producing the troublesome symptoms and describe this process in detail.

Useful Tools



Hints

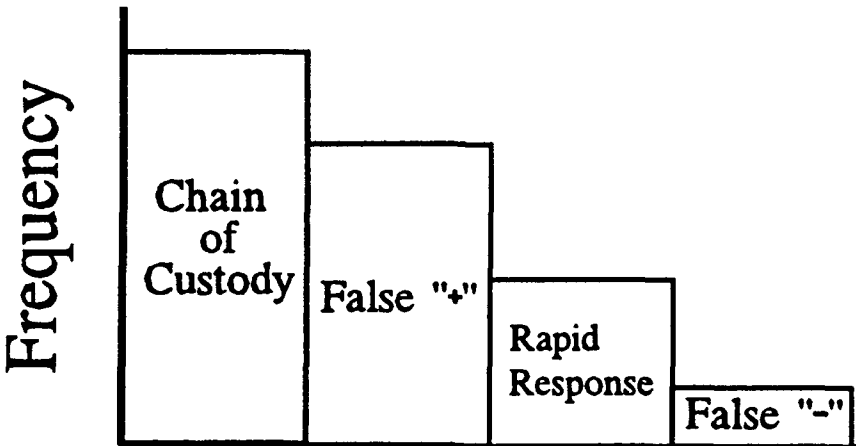
Notes & Data

Subdivide the process flow charting task by assigning team members to those aspects of the process they know best. Then bring the team back together to construct the composite process flow chart.

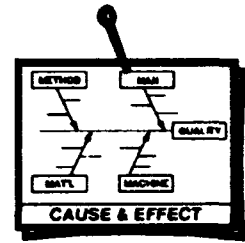
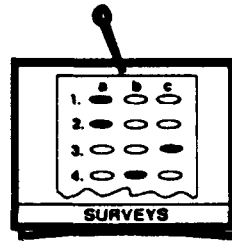
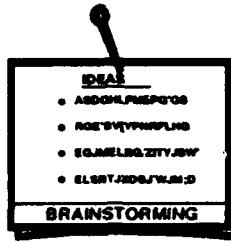
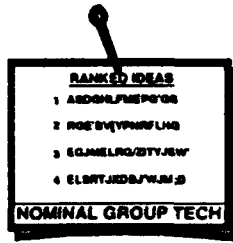
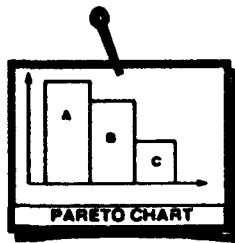
Invite non-team members to review and critique the process flow chart.

It is often useful to "Pareto," by category, how total process time is consumed by a process: operations, delays, movement, inspection, decision-making, and filing.

6 Identify key parameters for measuring customer satisfaction; establish targets for improvement whenever possible.

Hints	Example
<p><i>Which parameters are most important to the external customer?</i></p>	<p>POSSIBLE TARGETS: Step 2 revealed an average monthly load of 20,000 samples. A 25% increase in productivity would increase capacity to 25,000; a level encountered during peak workloads. If base closings double the workload, a mere cycle time improvement of 20-50% will be inadequate. Most importantly, until we get this process under statistical control we don't really know what it is capable of delivering.</p>
<p><i>Which process steps are most likely to positively influence these external, macro-measures of customer satisfaction?</i></p>	 <p>Key Parameters of Customer Satisfaction</p>
<p><i>Consider these possible measures of customer satisfaction:</i></p> <ul style="list-style-type: none"> cost on-time delivery productivity safety technological superiority cycle time 	<p>CAUTION: Ultimate success must be measured in customer terms. Make sure the parameters you track and improve are customer driven, not Quality Council driven. Customer agendas are usually straightforward; internal agendas can become distorted.</p>

Useful Tools



Hints

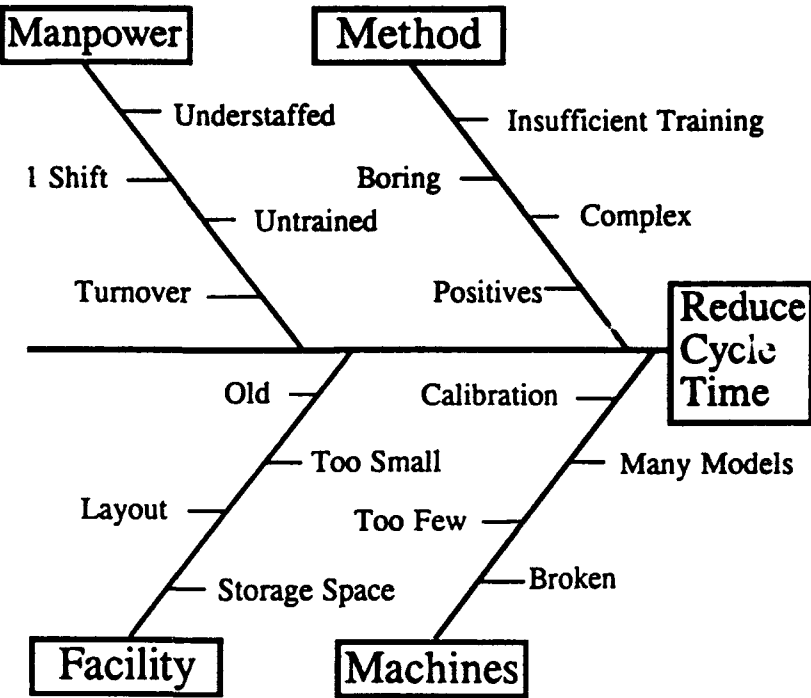
Notes & Data

Can the Quality Council or process owner estimate how much process improvement is required or anticipated?

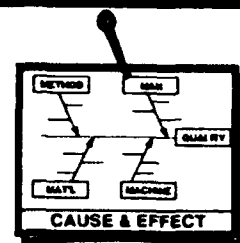
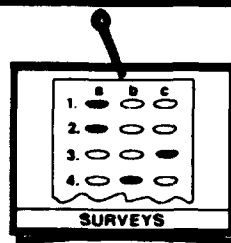
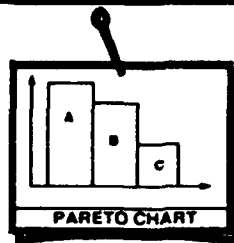
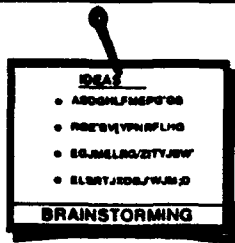
Have you realistically evaluated this process on its ability to meet or exceed key parameters of interest to the customer?

Should your team's "target" improvement goals exceed the customer's expectations rather than just meet them?

7 Identify the probable causes of, or barriers to, process improvement.

Hints	Example
<p><i>What are the possible causes leading to the symptoms identified in Step 4?</i></p> <p><i>It might help to refer back to the flow chart in Step 5 to see which process steps have the most impact on the outcome of the entire process.</i></p> <p><i>Are there any non-value added steps that should just be eliminated?</i></p>	<p>Using the Nominal Group Technique the Team identified the four most likely causes of inadequate "cycle times" in each of four categories: manpower, methods, machines and facilities. The resulting "cause and effect diagram" is shown below.</p>  <pre> graph LR Manpower[Manpower] --- U[Understaffed] Manpower --- IS[1 Shift] Manpower --- Untrained[Untrained] Manpower --- Turnover[Turnover] Method[Method] --- IT[Insufficient Training] Method --- Boring[Boring] Method --- Complex[Complex] Method --- Positives[Positives] Facility[Facility] --- Old[Old] Facility --- TooSmall[Too Small] Facility --- Layout[Layout] Facility --- StorageSpace[Storage Space] Machines[Machines] --- Calibration[Calibration] Machines --- ManyModels[Many Models] Machines --- TooFew[Too Few] Machines --- Broken[Broken] U --- RCT[Reduce Cycle Time] IT --- RCT Boring --- RCT Complex --- RCT Positives --- RCT Old --- RCT TooSmall --- RCT Layout --- RCT StorageSpace --- RCT Calibration --- RCT ManyModels --- RCT TooFew --- RCT Broken --- RCT </pre> <p>CAUTION: You will identify ten times more "probable causes" than you can ever hope to investigate. While brainstorming for ideas go for quantity. But once you have a list of probable causes, tap the knowledge of your best people to identify the one or two which promise the greatest potential for improvement. In short, you can't investigate everything so choose wisely that which you will study.</p>

Useful Tools



Hints

Notes & Data

Make sure you invite non-team members who work in the process constantly to offer their suggestions. Why not invite them to brainstorm their ideas on the matter.

If a given process step is on the flow chart because the step is supposedly required by policy or regulation, confirm the truth or inaccuracy of such a requirement.

Are problems arising because the process is unnecessarily complex?

8

Verify root causes of the problem with data.

Hints

Collect data on the probable causes identified in Step 7. Does your team know enough about variation and measurement to detect a root cause in a data set if its there?

Will senior management be convinced that a root cause has been identified if they review your data and method of analysis?

Once root causes have been verified, does team membership need to be changed in the interest of team effectiveness?

Example


HYPOTHESIS: One possible cause of long cycle times is the detection of a "positive" in a "lot" of samples from a customer. We want to test the hypothesis that the presence of a "positive" result increases the time required to process the "lot" containing said "positive." The following 30 "lots" of data were tabulated to test this possible "cause and effect" relationship.

		One or More Positives Per "Lot"	
		Yes	No
Time To Process "Lot"	20 + days	8	2
	1-20 days	1	19

The calculated Chi-square value of 17.9 exceeds the critical value of 3.84 at 95% confidence: the presence of one or more "positives" in a "lot" has a definite effect on total processing time for said lot.

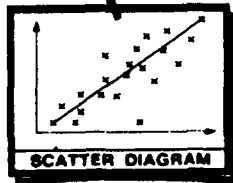

CAUTION: Three points! Avoid making decisions on main causes by voting. Voting is a democratic process but it may lead to incorrect conclusions. Secondly, have some number crunching skill on your team; you'll need it. But most importantly, once you've identified a root cause consider carefully how you are going to fix it?

Useful Tools



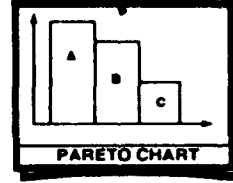
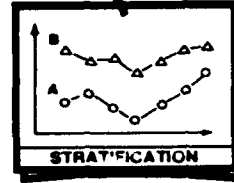
DEFECT	TYPE	Σ
A	11	7
B	111	4
TOTAL	8	11

CHECK SHEET

WHY?
WHY?
WHY?
WHY?
WHY?

ASK WHY 5 TIMES



Hints

How would you know if someone was providing the team "false" data out of fear, ignorance or malice? How could you request data in a less threatening or invasive way?

In the process of verifying root causes have you uncovered additional root causes? Are they significant enough to pursue? Does the rest of the team know of them?

Ask non-team members what kinds of data they would collect to verify a given root cause.

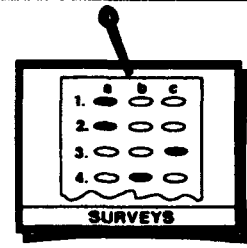
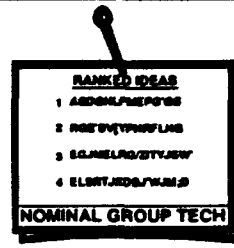
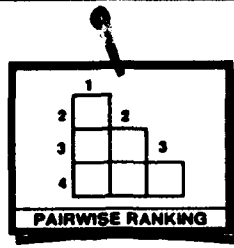
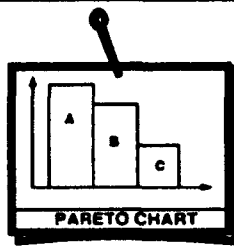
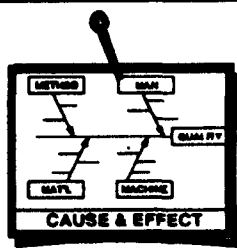
Notes & Data

9

Identify and prioritize possible solutions;
select the best alternative.

Hints	Example
<p><i>Have you asked the person who initially proposed the cause and effect relationship if they have a possible solution?</i></p> <p><i>Use "divergent" thinking to ensure the team looks at a number of alternatives, not just the first solution that comes to mind.</i></p> <p><i>Ask non-team members who actually do the work what they might propose.</i></p>	<p>ISSUE: A "positive" during drug testing of a "lot" of samples increases processing time. How can we eliminate the delays caused by "positives?"</p> <pre> graph LR Manpower[Manpower] --- MainLine Method[Method] --- MainLine Materials[Materials] --- MainLine Machines[Machines] --- MainLine MainLine --- Positives[Positives Cause Delays] Manpower --- Retest[Have "Retest" Analyst On Call] Method --- Report[Report + and - Separately To The Customer] Materials --- Storage[Improve Storage & Retrieval of Samples] Machines --- Reserve[Reserve 1 Machine For Retests Only] </pre> <p>CAUTION: The major concern here is similar to the "caution" given in Step 7; you will probably have more possible solutions than you could ever test. So pick carefully. If you are careless you might work on a solution that yields a 10% improvement while one of the "untested" solutions is capable of 1,000% improvement. And you'll never know how close you really were.</p>

Useful Tools



Hints

As in Step 7, search for solutions in the areas of manpower, machines, materials, facilities, methods., etc.

Consider using the pairwise-ranking approach to selecting among alternatives if your choices are few.

What does the process owner suggest in the way of solutions? How about the Quality Council?

Notes & Data

Develop and implement solution(s) on a small scale.

Example

The team decides to implement the plan outlined below. The purpose of the test is to determine if drug testing cycle time can be reduced significantly by reporting results on "positives" separately from the bulk of the "negatives" in a given "lot."

[illegible]

CAUTION: Is the implementation plan robust enough to prevent the occurrence of the Hawthorne effect; spurious improvements because people are being watched?

Useful Tools



Gantt
Chart

PERT
Chart

Critical
Path
Method

Hints

As you prepare an implementation plan to test the merits of your proposed solution, ask the "5 Why's and 1 How" to clearly specify who will do what, where, when, why and how. Produce a schedule of key milestones.

If multiple solutions are to be tested at the same time, schedule them in such a way that you can tell which actions produce results and which do not.

During implementation, check to make sure the plan unfolds as scheduled. If it doesn't, find out what has changed and take corrective action as required.

Notes & Data

11

Evaluate and confirm improvement to the process.

Hints

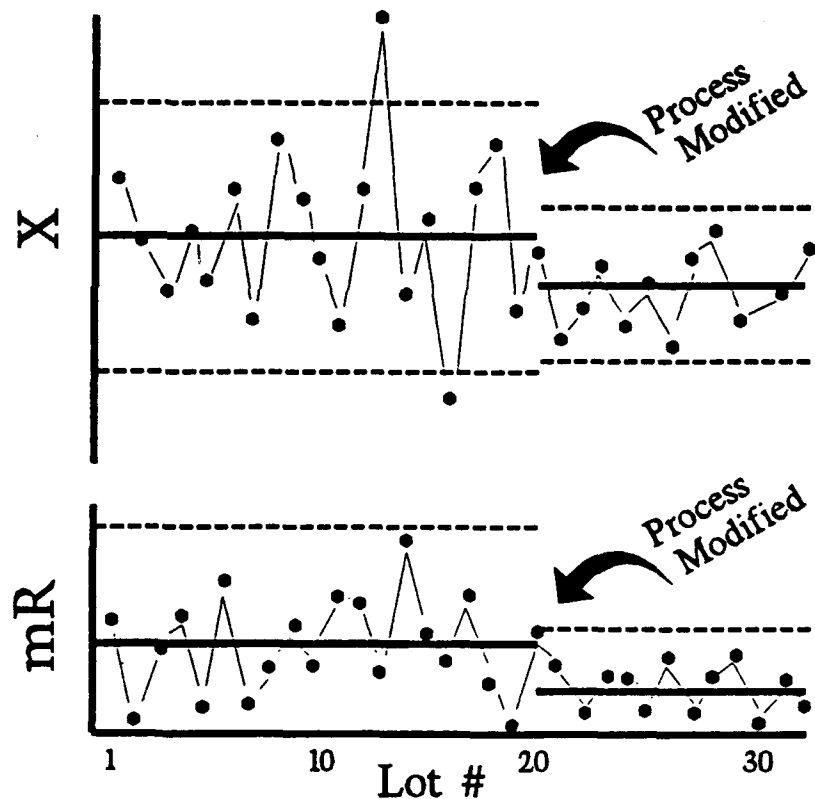
Did the results meet the targets initially set for improving this process?

Was the purpose of this activity to influence the process average, reduce process variability, or both? Which, if any, occurred?

What intangible benefits resulted from this process improvement activity?

Example

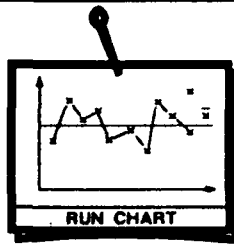
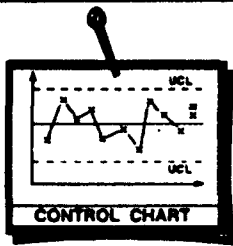
The Team executes the plan outlined in the previous step, and observes the following results.



XmR Chart For Drug Testing Cycle Time

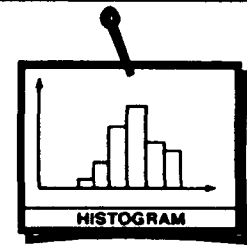
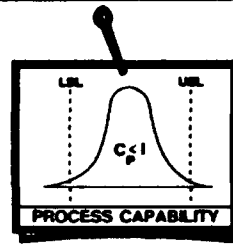
CAUTION: Everyone perceives improvement in their own relative terms. Make sure that your external customer believes any "claimed" improvement is real and significant. It doesn't really matter what the Quality Council or process owner think about the extent of improvement; perception is reality to the customer.

Useful Tools



DEFECT	TYPE	C	Σ
A	II	MT	7
B	III	I	4
TOTAL	5	6	11

CHECK SHEET



Hints

Notes & Data

*How well was the plan executed?
What would you do differently next time?*

Can you document the benefits of this action in dollars & cents, increased quality, improved safety, etc?

What did the team learn about the process of continuous improvement?

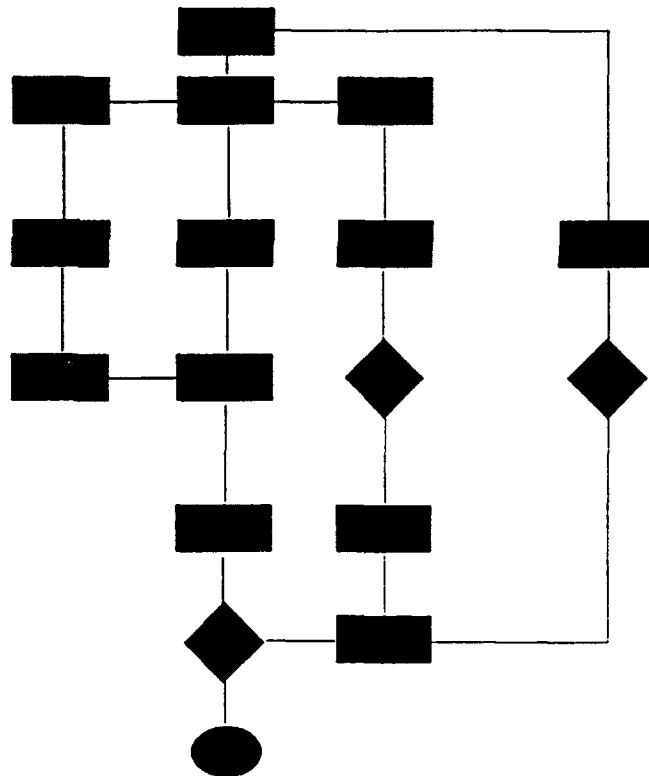
Standardize the process improvements.

Example

The following flow chart is the revised drug testing process which led to the improvements confirmed in Step 11.

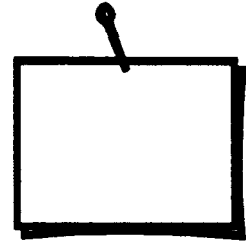
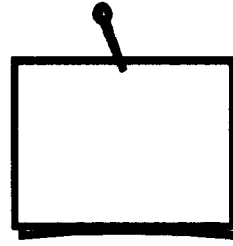
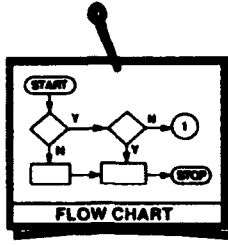
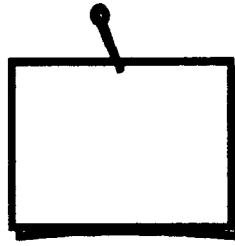
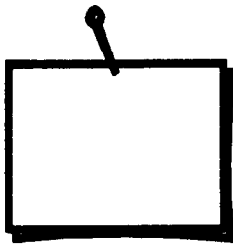
It is the endurance of the improved results that makes them meaningful. How are you going to ensure the improvements last?

How and when will all employees affected by these process changes be trained in the new way of doing their jobs?



CAUTION: Change is always difficult, especially when it affects us personally. No matter how great you think this improvement is, the workers whose lives are affected by it, but who were not on the Team, probably do not see it as positively as you do. Help them to understand what's in it for them.

Useful Tools



Hints

*Do all of the major stakeholders like your proposed process changes?
Don't standardize a process change that is offensive to any stakeholders; especially the external customer.*

Do you intend to collect data on the new process to ensure it doesn't degrade? How often will you check? Who will collect and analyze the data? How long will you continue to monitor it?

Have you considered empowering the workers to track the indicators and record the data necessary to keep the process "in control?"

Notes & Data

Useful Tools



Party

Recognition

Celebration

Recognition

Party

Hints

How can you involve the families and co-workers of the Team members in the celebration activities?

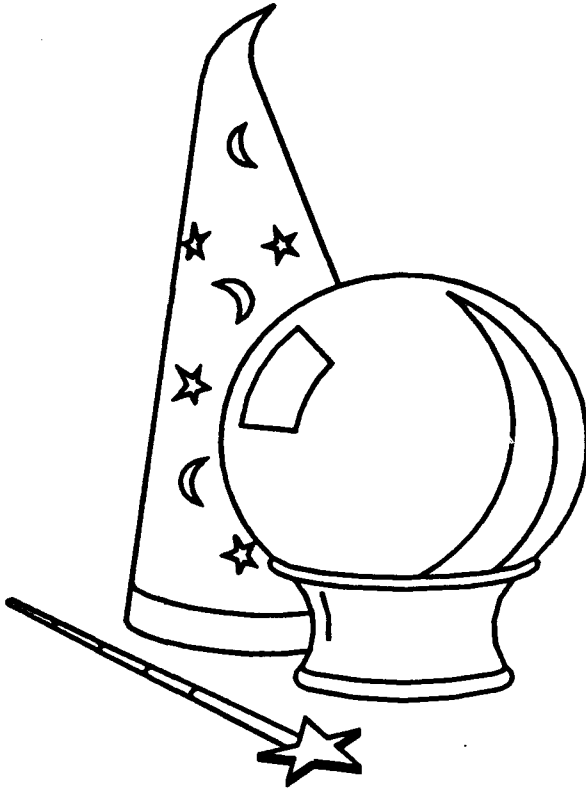
What additional TQL training can you provide select Team members as a form of recognition/reward?

Is there some way in which the external customer can participate in celebrating with the Team?

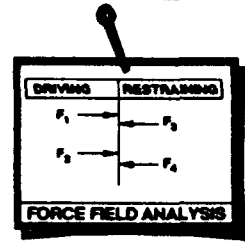
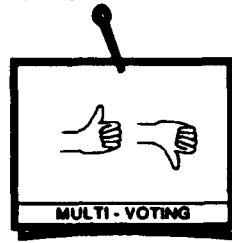
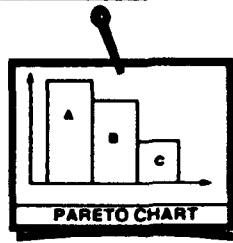
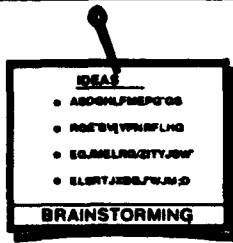
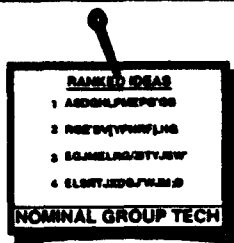
Notes & Data

14

Anticipate and plan future improvements.

Hints	Example
<p><i>It is not a good idea to focus on the same activity for too long. If the original time limit has been reached and the Team has not yet reached its original objectives, consider redefining the scope of their activities to ensure a timely conclusion of their work.</i></p> <p><i>Did the Team uncover any systemic problems that might be plaguing other groups? Could these groups benefit by reviewing what this Team learned?</i></p> <p><i>During executive briefings has the Team provided senior management with a list of important problems yet to be addressed?</i></p>	<p>So where does one go from here?</p>  <p>CAUTION: As noted previously, there are problems everywhere, large and small. There will be a tendency for this Team to want to solve the other problems they've discovered during their journey. It is important that they close out this activity completely before starting another, and that they negotiate permission to perform additional "team" work with the Quality Council. Only the Quality Council should be chartering process improvement activities. Why? Read Step 1 again!</p>

Useful Tools



Hints

How do you intend to share your "lessons learned" with others?

Team members have learned some valuable lessons during this activity. That knowledge is too important to waste. Maximize its value by ensuring that the original team members work on different teams in the future. Don't simply reform the old team because it worked well.

Some Team members may need a break between team assignments to catch their breath. You can have too much of a good thing.

Notes & Data

Attachment 2.1 - Customer Identification

When Prepared: Analytical Services Customers - Aug 92
FY92 Customers by Command - Oct 92

Need/Purpose: To identify the customers and examine their impact on our organization

How: Analytical Services Customers - Developed through database search.
FY92 Customers by Command - Designed with data management information system.

ANALYTICAL SERVICES CUSTOMERS

OE DIVISIONS

COMMAND BIOENVIRONMENTAL ENGINEERS

BASE BIOENVIRONMENTAL ENGINEERS

COMMAND CIVIL ENGINEERS

BASE CIVIL ENGINEERS

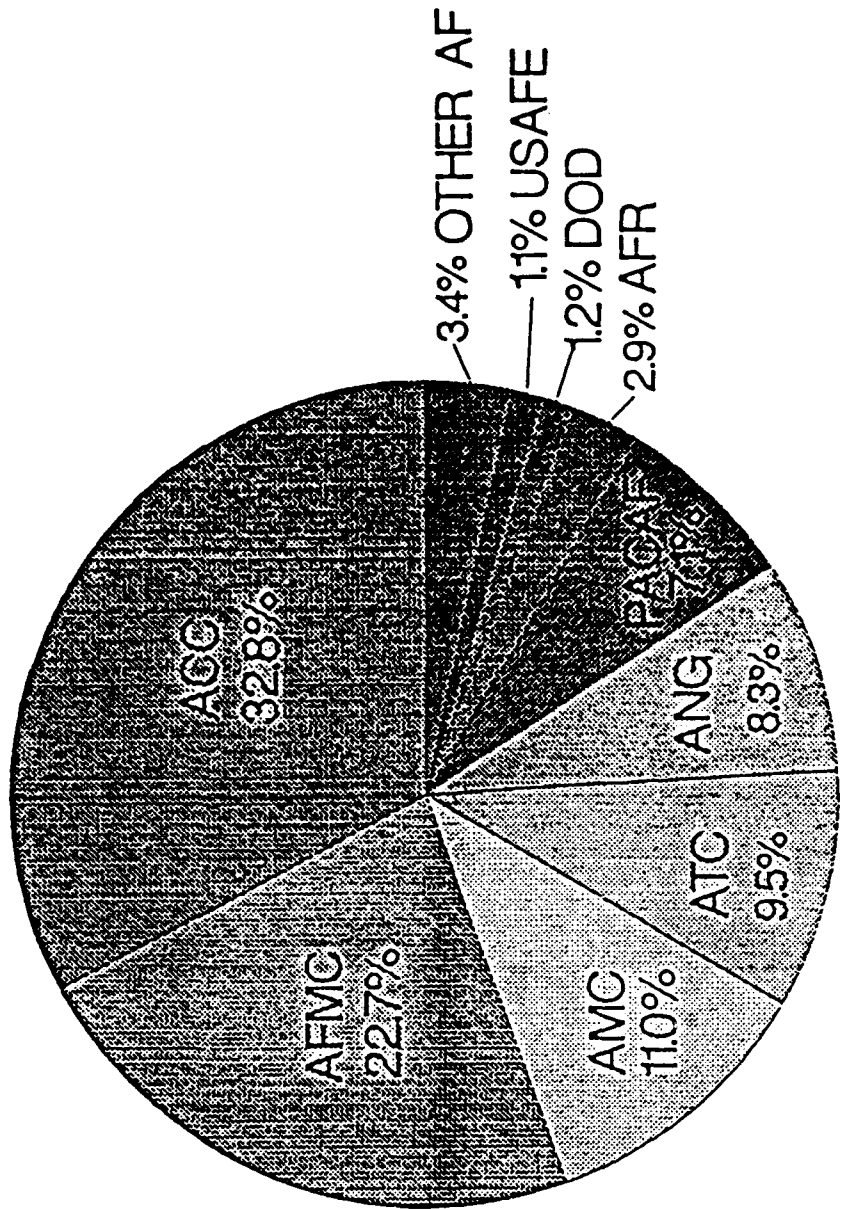
BASE ENVIRONMENTAL MANAGEMENT GROUPS

OTHER DOD AGENCIES

FEDERAL/STATE/PRIVATE AGENCIES

FY92 Customers By Command

74,816 Samples



Attachment 2.2A - Tools Used to Survey Customers

When Prepared: Environmental Sample Analysis
Questionnaire - 20 Nov 92

Need/Purpose: Team needed to know customer's desires of services provided. With this knowledge these key desire areas could be focused on by the PIT group.

How: Questionnaire developed with guidance from Deputy Director of OE Directorate.



DEPARTMENT OF THE AIR FORCE
ARMSTRONG LABORATORY (AFMC)
BROOKS AIR FORCE BASE, TEXAS

gell

20 NOV 1992

FROM: AL/OE
2402 E DP
BROOKS AFB TX 78235-5114

SUBJ: Environmental Sample Analysis Questionnaire

TO: See Distribution List

1. We previously announced a Symposium on Environmental Analytical Laboratory Efficiency will be held 30 Nov-2 Dec 92 at Brooks AFB TX. Your organization has been identified as providing analytical services for a sector of the Air Force's environmental samples. At attachment 1 you will find a copy of the questionnaire. Request you complete and telefax to us at DSN 240-2025 by 27 Nov 92.

2. At attachment 2 is a copy of the draft agenda, some minor changes may occur between now and the symposium. The billeting arrangements must be made by the traveler (see atch 3); transportation will be provided from the hotel to Brooks AFB.

ERIK K. VERMULEN
Deputy Director, Occupational and
Environmental Health Directorate

3 Atch

1. Questionnaire (Laboratory)
2. Agenda
3. Billeting/Transportation
Information

QUESTIONNAIRE

ENVIRONMENTAL LABORATORY WORKLOAD

AND

OPERATIONAL COST DATA

PURPOSE OF QUESTIONNAIRE: This questionnaire has been prepared to gather workload and operational cost data on Air Force environmental testing laboratories. These data are required to respond to a Congressional mandate for the Department of Defense to provide, as part of the FY94 Budget Request, "a complete construction, support cost, contractor cost and personnel breakout, by component and installation, of all spending associated with the operation and maintenance of all laboratories with current or potential environmental analysis capabilities."

POINT OF CONTACT: If you have questions pertaining to the information being sought or need help in filling out this questionnaire, call:

DSN _____

Comm _____

QUESTIONNAIRE

PART I - GENERAL INFORMATION

1. OFFICIAL NAME OF LABORATORY:

2. OFFICE SYMBOL/CODE: _____

3. NAME OF LABORATORY POINTS OF CONTACT:

LABORATORY DIRECTOR _____

QUALITY ASSURANCE DIRECTOR _____

4. PHONE NUMBER:

DSN _____
COMM _____

FAX NUMBER:

DSN _____
COMM _____

5. PARENT ORGANIZATION NAME, OFFICE SYMBOL & ADDRESS:

6. PARENT COMMAND: _____

7. COMPLETE MAILING/CORRESPONDENCE ADDRESS:

8. SAMPLE SHIPMENT AND/OR STREET ADDRESS (IF DIFFERENT FROM MAILING ADDRESS):

PART I - GENERAL INFORMATION (continued)

9. YEAR THAT LABORATORY BECAME (OR WILL BECOME) OPERATIONAL
(for environmental testing): _____

10. NUMBER OF LABORATORY SHIFTS: 1 | ☐ | 2 | ☐ | 3 | ☐ |

11. HOURS OF OPERATION: 1ST SHIFT _____ AM - _____ PM
2ND SHIFT _____ PM - _____ PM
3RD SHIFT _____ PM - _____ AM

12. FACILITY INFORMATION:

YEAR CONSTRUCTED: _____

YEAR OF LATEST MODIFICATION/RENOVATION: _____

FACILITY SIZE: [Only include space used for or in support of analytical (direct testing) work or occupied by personnel directly supporting the analytical laboratory mission. Include the following areas: chemical/material storage rooms; sample receipt/storage areas; LIMS data control/computer room; and utility/heating/cooling system rooms; hallways; restrooms; personnel break areas.]

TOTAL FACILITY:

ANALYTICAL SPACE: _____ SQ FT
ADMINISTRATIVE/OFFICE SPACE: _____ SQ FT

ENVIRONMENTAL MISSION:

ANALYTICAL SPACE: _____ SQ FT
ADMINISTRATIVE/OFFICE SPACE: _____ SQ FT

13. LABORATORY TEST EQUIPMENT:

What is the total value of ALL ACCOUNTABLE equipment used to perform (and support) the laboratory environmental testing mission? _____ [Data can be obtained from the Custodian Authorization/Receipt Products List (CA/CRL)]

What is the total value of ALL CAPITAL equipment (items costing \$15,000 or more) used to perform (and support) the laboratory environmental testing mission? _____ [Data can be obtained from the Custodian Authorization/Receipt Products List (CA/CRL)]

Please furnish a current copy of your CA/CRL along with the completed questionnaire.

PART II - LABORATORY MISSION/WORKLOAD INFORMATION

1. What is the mission(s) of the analytical laboratory? Please check all appropriate blocks.

- ☐ Medical (Industrial Hygiene/Occupational Health)
☐ Medical (Clinical)
☐ Environmental Compliance (SDWA/RCRA/TSCA/CWA/CAA, etc.)
☐ Environmental Restoration (IRP/CERCLA)
☐ QA/QC (Industrial Processes)
☐ QA/QC (Fuels/Lubes, Propellants, Chemicals)
☐ Other: _____
☐ Other: _____

2. **SAMPLE WORKLOAD:** [A "sample" is defined as a product, material, or substance (either natural matrix or man-made) submitted to a laboratory for testing and identified with a unique customer (i.e., field) control number. Multiple containers of the same matrix which are submitted to comply with the containerization and preservation requirements of various analytical methods DO NOT constitute separate "samples" for the purposes of this tabulation, even when assigned separate laboratory control numbers.]

TOTAL NUMBER OF SAMPLES RECEIVED (ALL MISSIONS):

FY92 _____
FY91 _____
FY90 _____
FY89 _____

TOTAL NUMBER OF ENVIRONMENTAL COMPLIANCE SAMPLES RECEIVED:

FY92 _____
FY91 _____
FY90 _____
FY89 _____

TOTAL NUMBER OF ENVIRONMENTAL RESTORATION SAMPLES RECEIVED:

FY92 _____
FY91 _____
FY90 _____
FY89 _____

PART II - LABORATORY MISSION/WORKLOAD INFORMATION (continued)

3. **FY92 ENVIRONMENTAL TEST/ANALYSIS WORKLOAD:** [A "test" or "analysis" is defined as a laboratory procedure performed in accordance with a documented analytical method for the purpose of determining specific constituents in a sample or the physical and chemical properties of the sample (see definition of sample above)]

ENVIRONMENTAL TEST CATEGORY	NUMBER OF TESTS
Physical Properties (Water & Wastewater)	_____
Inorganic Water Quality, Non-Metals	_____
Inorganic Water Quality, Metals	_____
General Screening Tests for Organics (Aggregate) in Water & Wastewater	_____
Organics in Water & Wastewater	_____
Radioactivity in Water	_____
Biological Examination of Water	_____
Microbiological Examination of Water	_____
Hazardous Waste Characterization, Metals	_____
Hazardous Waste Characterization, Organics	_____
Hazardous Waste Characterization, Radioactivity	_____
Hazardous Waste Characterization, Physical Properties, Inorganics, Miscellaneous	_____
Site Characterization, Metals	_____
Site Characterization, Organics	_____
Site Characterization, Radioactivity	_____
Site Characterization, Miscellaneous	_____
Asbestos	_____
TOTAL NUMBER OF ENVIRONMENTAL TESTS/ANALYSES PERFORMED IN FY92:	_____

PART III - PERSONNEL INFORMATION

1. TOTAL NUMBER OF LABORATORY PERSONNEL (ALL MISSIONS):

MILITARY: _____ **CIVILIAN:** _____

2. TOTAL NUMBER OF PERSONNEL SUPPORTING ENVIRONMENTAL MISSION:

MILITARY: _____ **CIVILIAN:** _____

3. ORGANIZATIONAL STRUCTURE SUPPORTING ENVIRONMENTAL MISSION:

A. TOTAL NUMBER OF SUPERVISORS: _____

GRADE/RANK	NUMBER
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

B. TOTAL NUMBER OF ADMINISTRATIVE/SUPPORT PERSONNEL: _____

GRADE/RANK	NUMBER
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

C. TOTAL NUMBER OF DIRECT LABORATORY PERSONNEL: _____ **

GRADE/RANK	NUMBER
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

****ONLY INCLUDE CHEMISTS/TECHNICIANS WITH "HANDS-ON" INVOLVEMENT IN ENVIRONMENTAL ANALYSIS; DO NOT INCLUDE QUALITY ASSURANCE PERSONNEL IN THIS CATEGORY.**

PART III - PERSONNEL INFORMATION (continued)

3. (continued)

D. TOTAL NUMBER OF QUALITY ASSURANCE PERSONNEL: _____

GRADE/RANK	NUMBER
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

E. TOTAL NUMBER OF OTHER PERSONNEL (IF APPLICABLE): _____

GRADE/RANK	NUMBER	BRIEF STATEMENT OF DUTIES
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

PART IV - COST OF LABORATORY OPERATIONS

1. Within which Major Force Programs (MFP) do your laboratory testing operations fall? List all applicable MFPs and the percentage of total laboratory funding applicable to each:

MFP _____ %

MFP _____ %

MFP _____ %

Which of the above MFPs covers environmental testing? _____

2. Provide FY92 data on total laboratory expenditures (all missions and all MFPs) for the following: [Round values to the nearest \$100]

EXPENSE CATEGORY	EEIC	DOLLARS SPENT, FY92
Materials/Supplies	6XX	\$ _____
Equipment Maintenance/ Repair	569	\$ _____
Small Equipment Items	628	\$ _____
Utilities		\$ _____
Travel (non-training)	40X	\$ _____
Lab Certification Fees		\$ _____
Overtime Pay	391	\$ _____
Petty Cash	619	\$ _____
Training (course fees plus travel)		\$ _____
Other: _____		\$ _____
Other: _____		\$ _____
Other: _____		\$ _____
TOTAL FY92 EXPENDITURES FOR LABORATORY OPERATIONS		\$ _____

PART IV - COST OF LABORATORY OPERATIONS (continued)

3. Does the laboratory directly pay (out of its operational funds) the Permanent Change of Station (PCS) expenses associated with moving civilian personnel within your laboratory organization or when hiring them from other Air Force or Federal agencies or from the private sector?

☐ Yes ☐ No

If above answer is "Yes," how many such movements or hires typically occur (on the average) each year? _____.

4. Does the laboratory pay (out of its operational budget) for contractors (or contractor personnel) to test a portion of the samples received in the laboratory? DO NOT include samples sent to a contract laboratory where analyses are paid for by the customer using mechanisms such as MIPRs.

☐ YES ☐ NO

Are these contractor services provided on-sight at the government laboratory facility?

☐ YES ☐ NO

What is the annual cost of these contract services?
\$_____.

What percentage of the total laboratory workload is analyzed by contract or contractor personnel?
_____ %

PART V - OTHER INFORMATION

1. Please list your laboratory certifications:

[illegible]

* e.g. Drinking Water (SDWA), NPDES, etc.

Attachment 2.3A - Customer Satisfaction Data

When Prepared: Key parameters for measuring customer satisfaction: Dec 92

Need/Purpose: To find customer's key desires on our services provided.

How: Team discussed customer feedback and matrix prioritization data, listed customer desires in order of priority. Team used this valuable information in zeroing in on improvements that would satisfy customers the most.



KEY PARAMETERS FOR MEASURING CUSTOMER SATISFACTION

- 1. FAST ANALYSIS TURNAROUND TIMES**
- 2. CAPABILITY TO PROVIDE EMERGENCY ANALYSES**
- 3. RESULTS TO SATISFY STATE AND FEDERAL REGULATIONS**
- 4. ON THE SPOT TELEPHONE CONSULTATIVE HELP**
- 5. QUICK LAB RESPONSE TO CHANGING REGULATIONS**
- 6. ANALYSIS METHOD DEVELOPMENT FOR SPECIAL STUDIES**
- 7. QUALITY OF RESULTS**

***CUSTOMER SURVEY AT LAB CONSOLIDATION MEETING 30 NOV-2
DEC 1992**

Attachment 2.4A - Flow Chart and Study of Analytical Chemistry Processing Steps in the Laboratory

When Prepared: June 1992

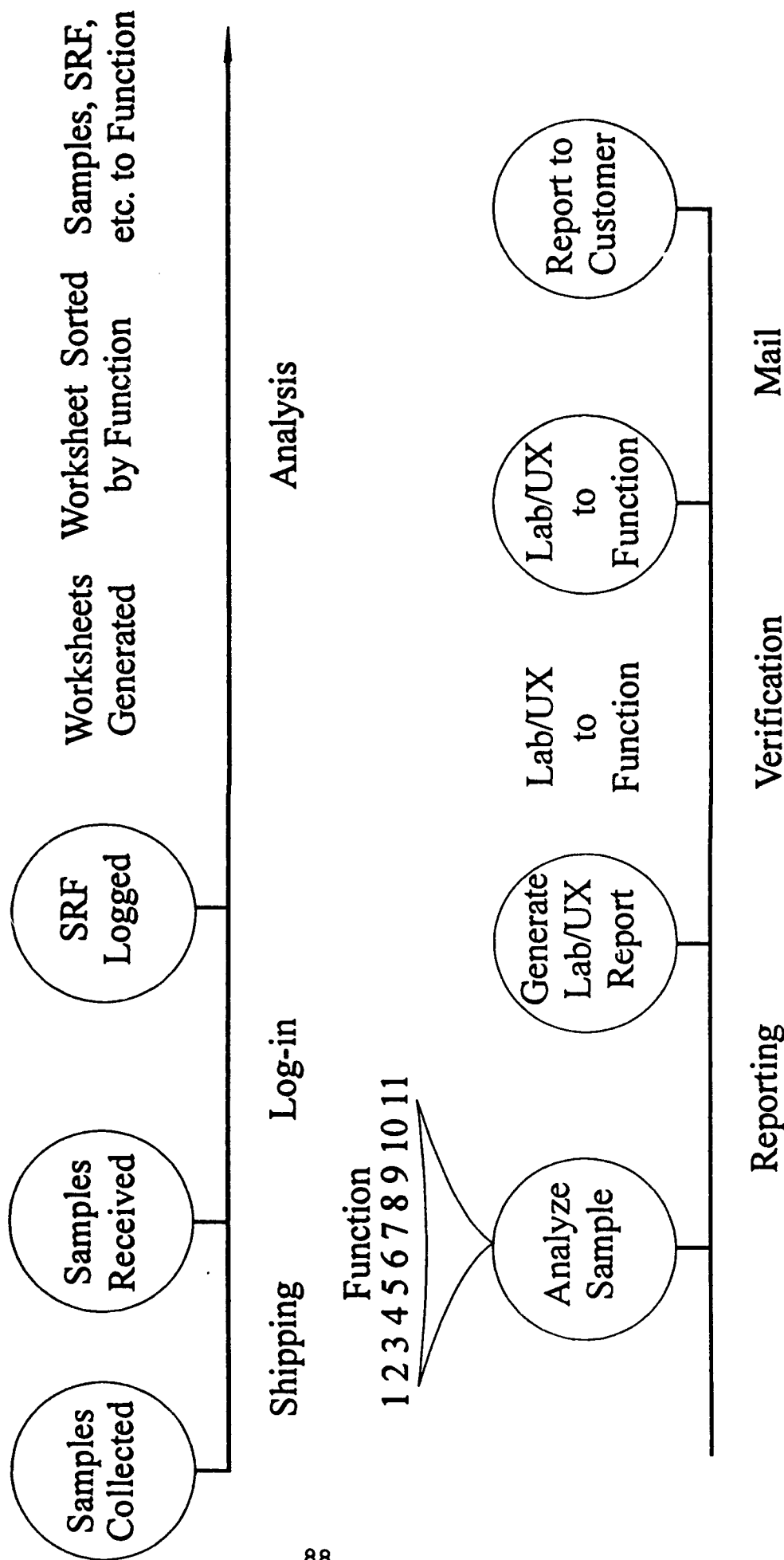
How: Dr Cupello and Mr Thomas made a detailed tour of the Division. They brainstormed together and came up with the flow chart.

From actual times for each process stored in the Lab's Information Management System, Box and Whisker Diagram for 1 Jan - 2 Jun 92 data was developed. This showed times required for each process step.

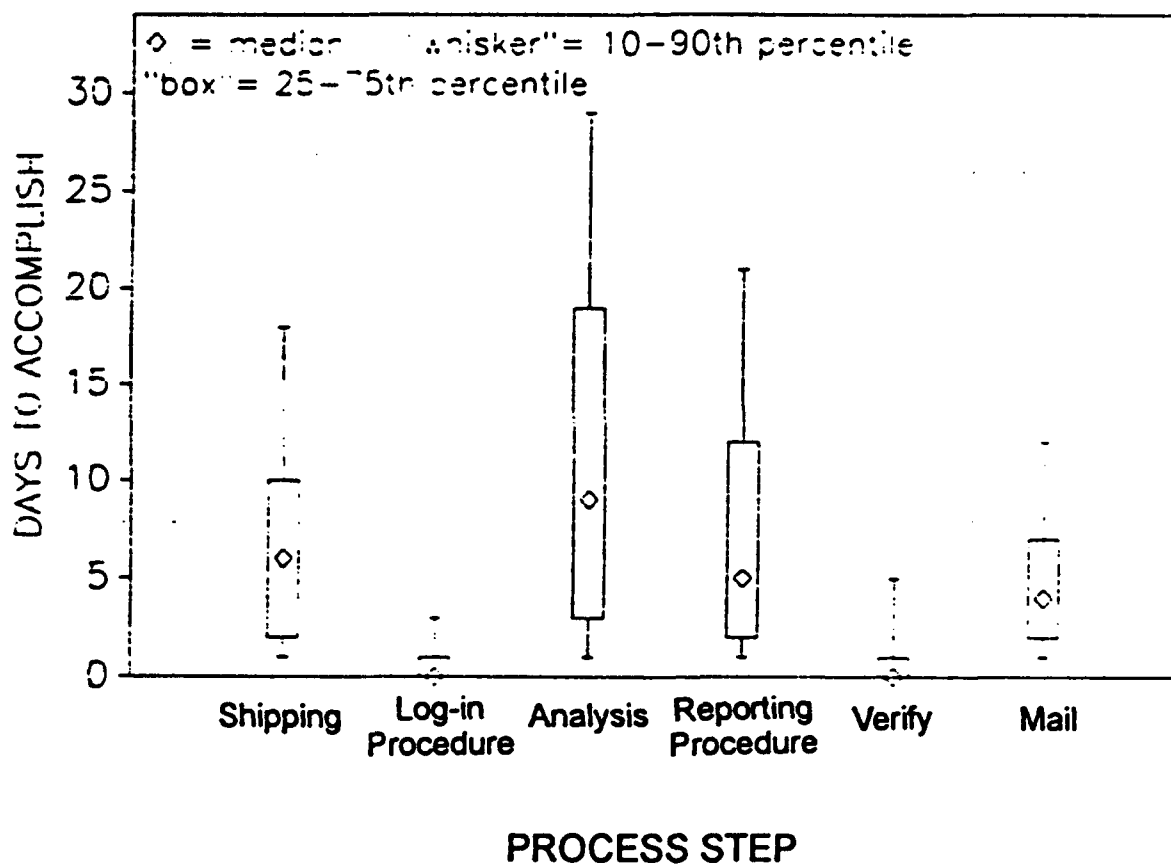
Analysis times were also stored in the Laboratory Information Management System. Each analysis function, 1-11, was broken down and plotted. The Box and Whisker Diagrams show analysis turnaround times.

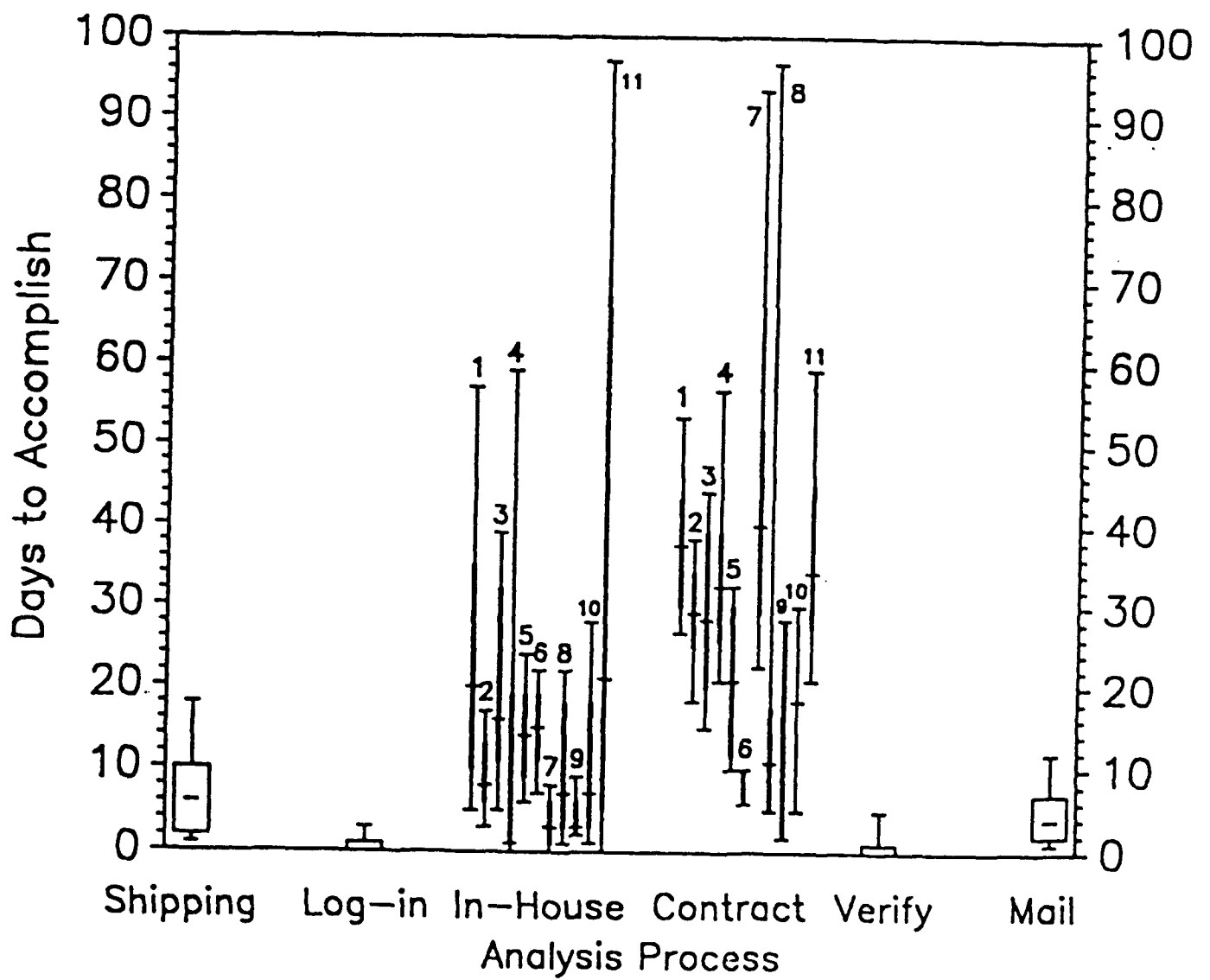
Make Note Of: See chart for functions represented by 1-11.
SRF is short for Sample Request Forms.
LAB/UX is Laboratory Information Management System.

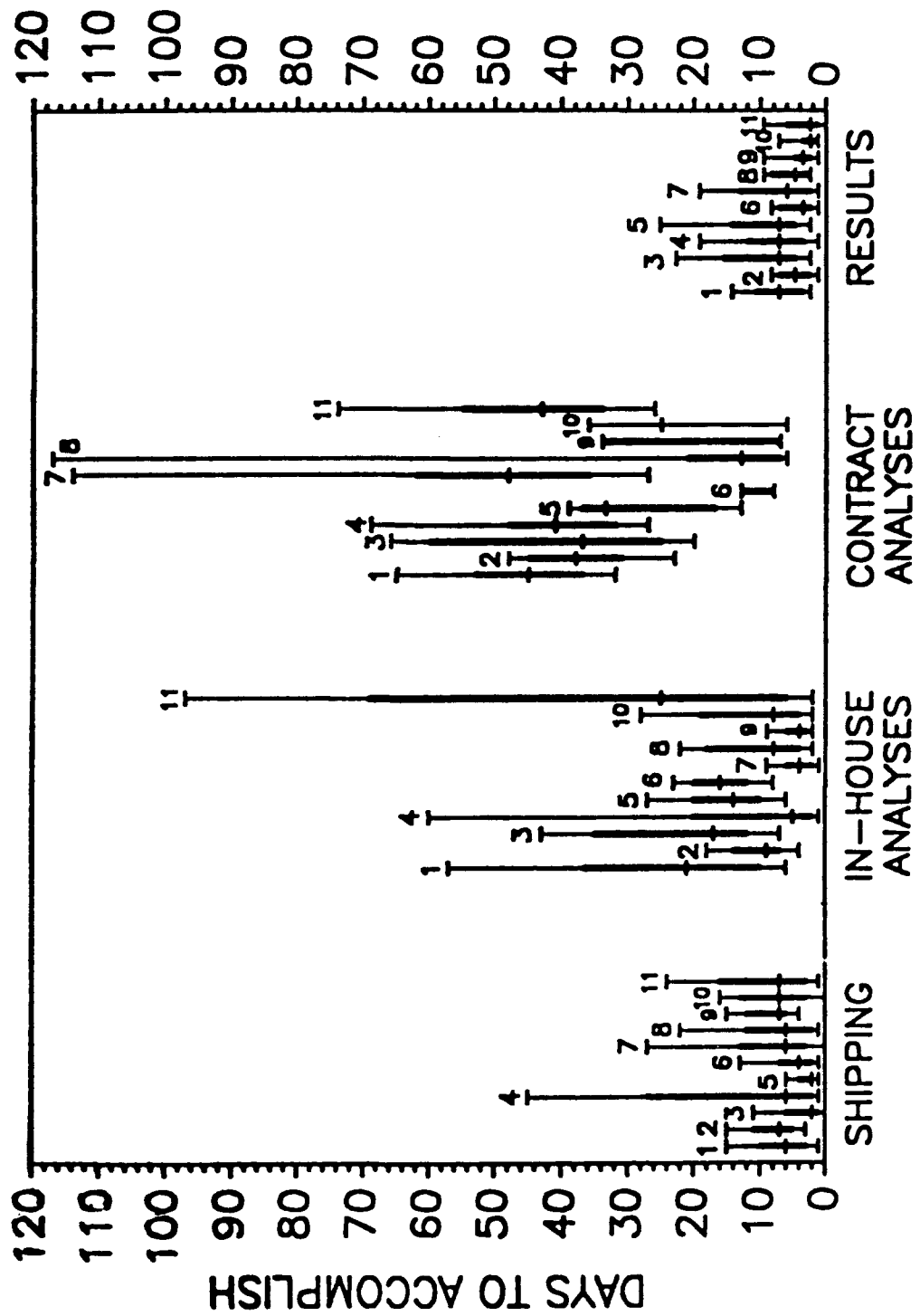
PROCESS STEPS



<u>CODE</u>	<u>FUNCTION</u>
1	Metals
2	Industrial Hygiene
3	GC/MS
4	Pesticides
5	Volatile Organics
6	Inorganics
7	Bulk Asbestos
8	Air Asbestos
9	Air Particulates
10	Commercial Products
11	Haz/Tox







Attachment 2.6 - Evaluation of Process Performance

When Prepared: Control Charts/Scatter Diagrams -
Sep/Oct 92

Need/Purpose: By looking at historical performance records, the areas of "improvement opportunities" will become evident

How:

Samples Received: Control Charts showed two year record of incoming samples, listing variances and yearly means.

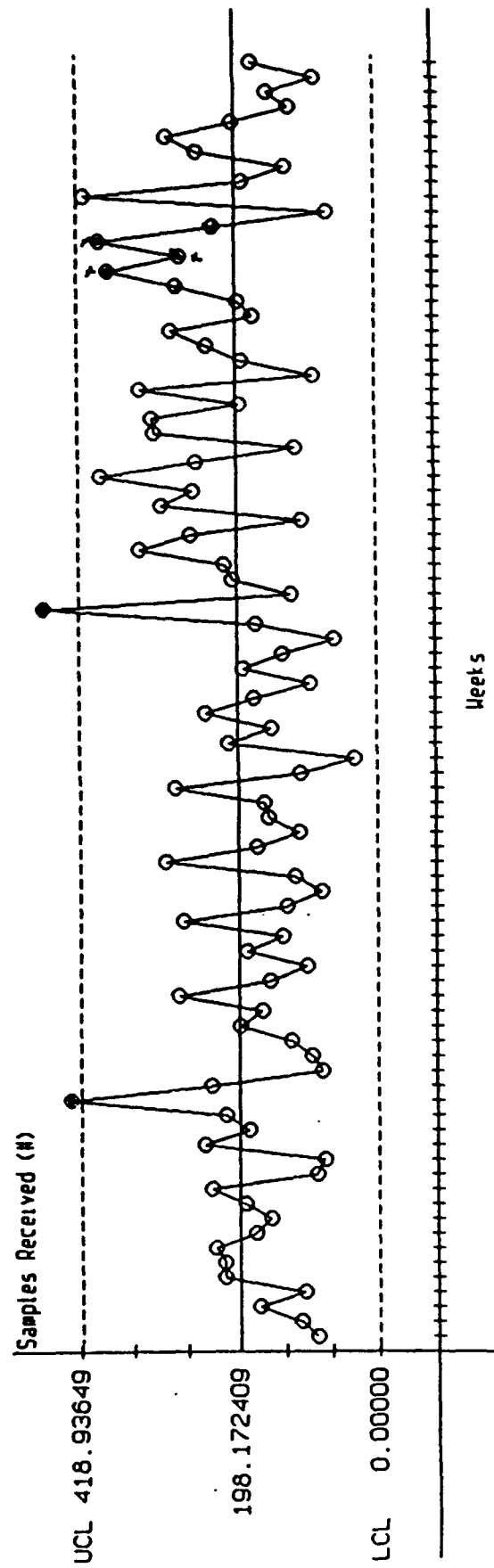
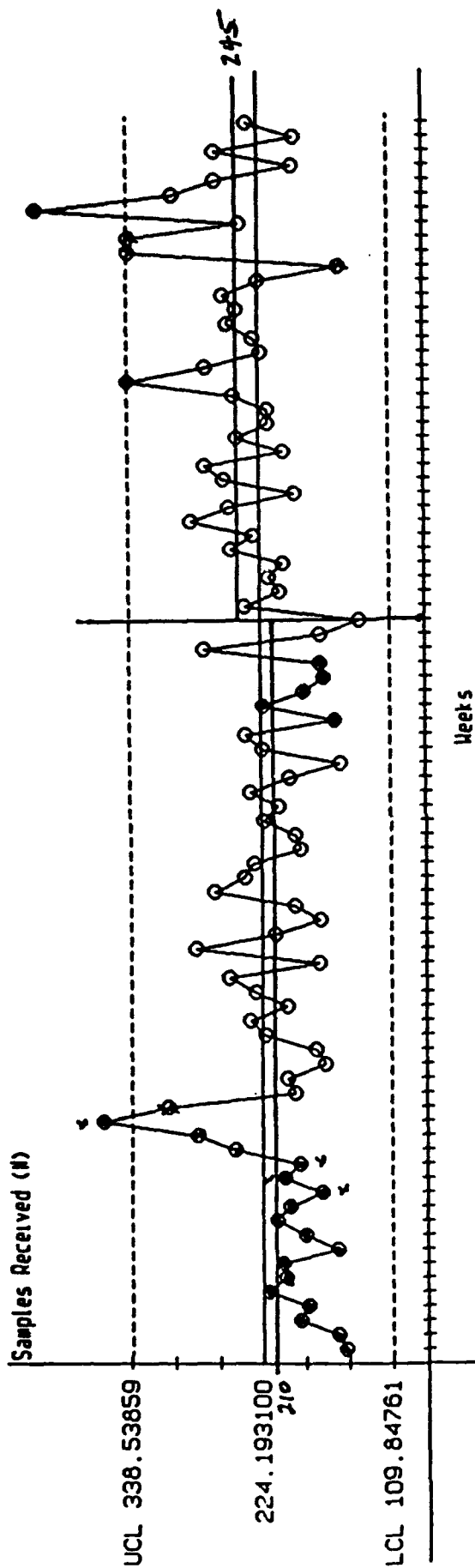
Analysis Turnaround Times: Control Charts were developed for functional analysis areas, showing variance in analysis times and overall means.

Scatter Diagrams: Used to compare analysis time versus analyses requested.

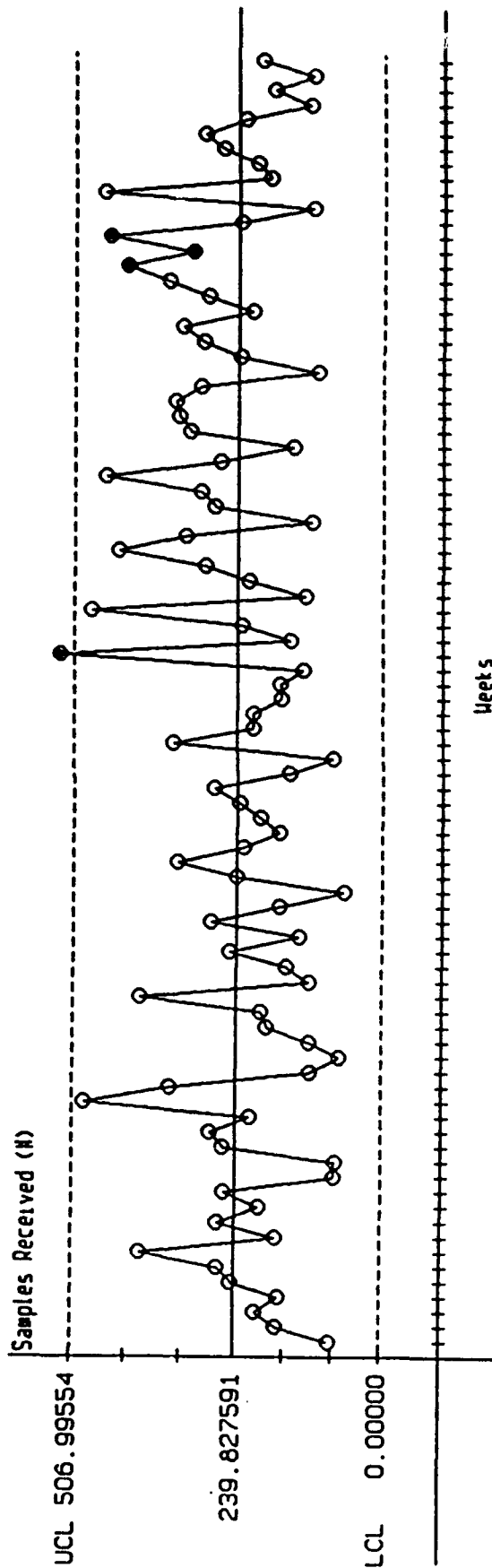
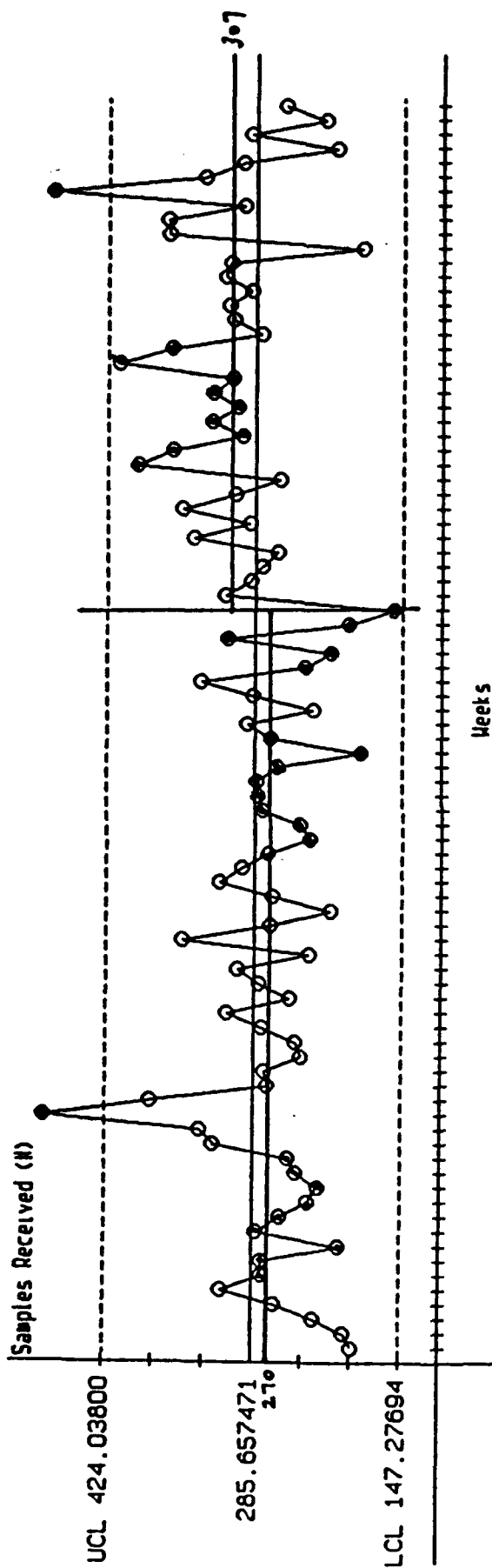
Pareto Chart: Looked at top workload drivers in each analysis function.

These charts were developed by team members from LAB/UX data and discussed/analyzed at our meetings. These data charts helped us better understand the process and its problems.

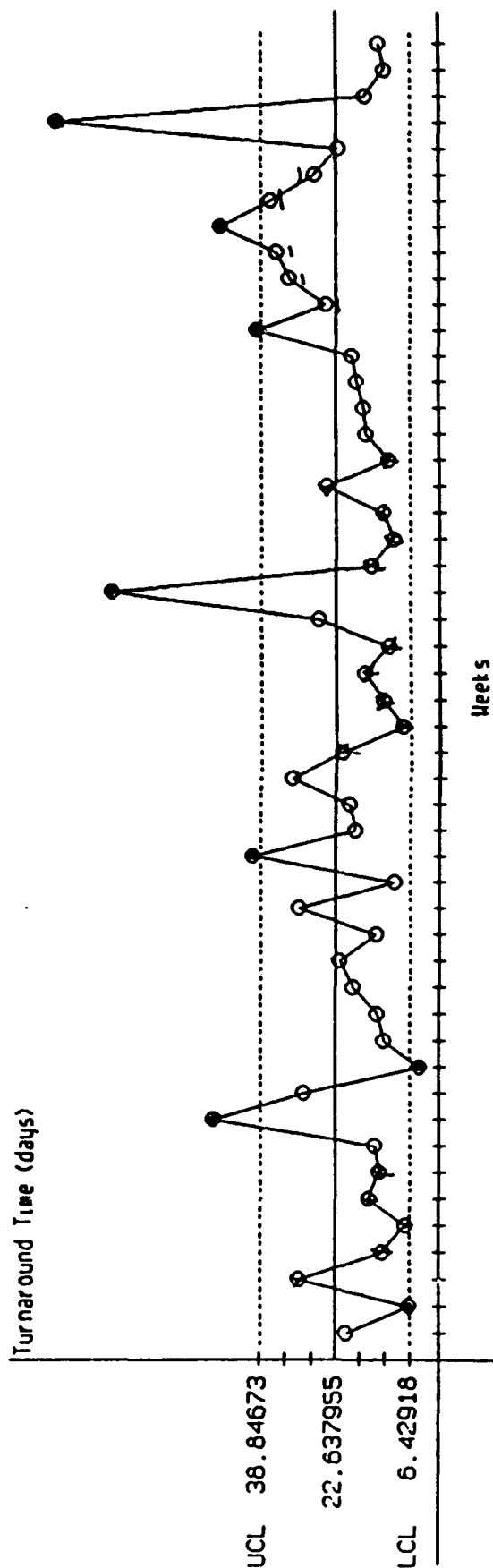
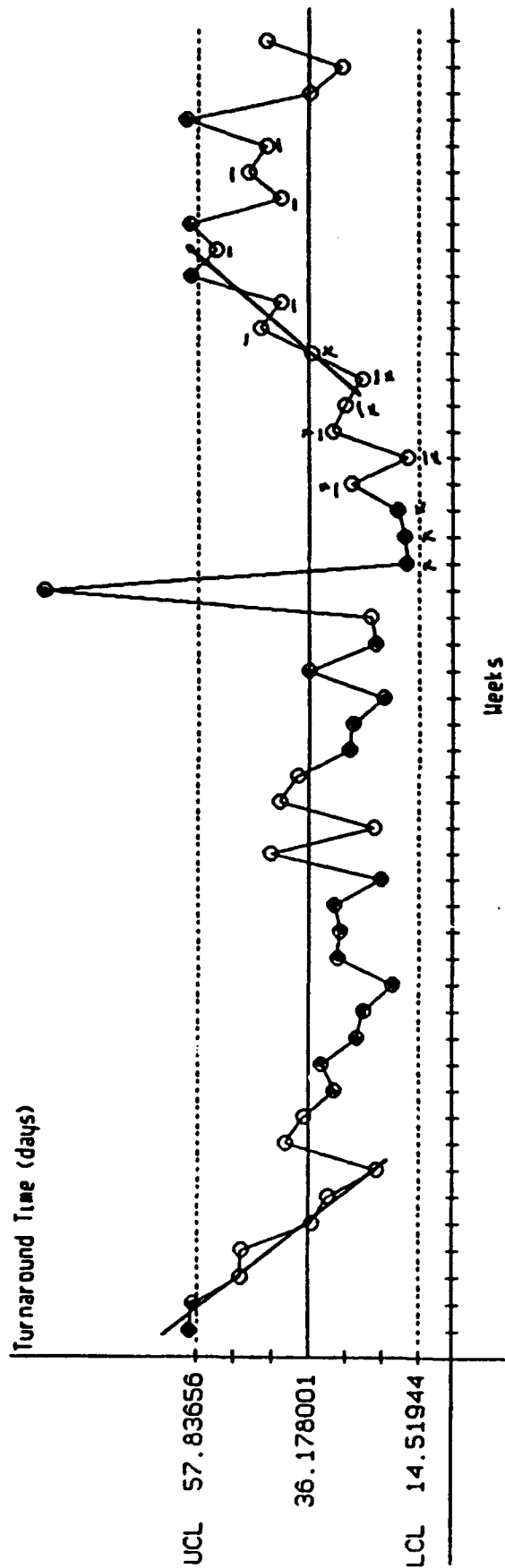
OEA WEEKLY SAMPLES RECEIVED 1991-1992 All Functions Combined (In-House)



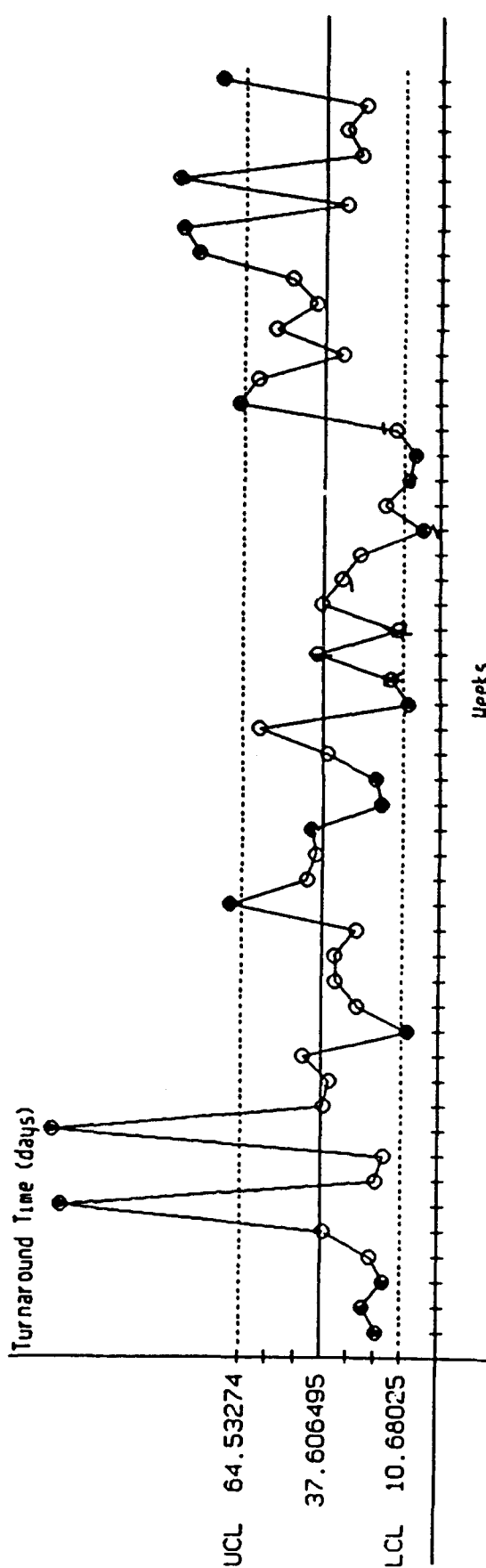
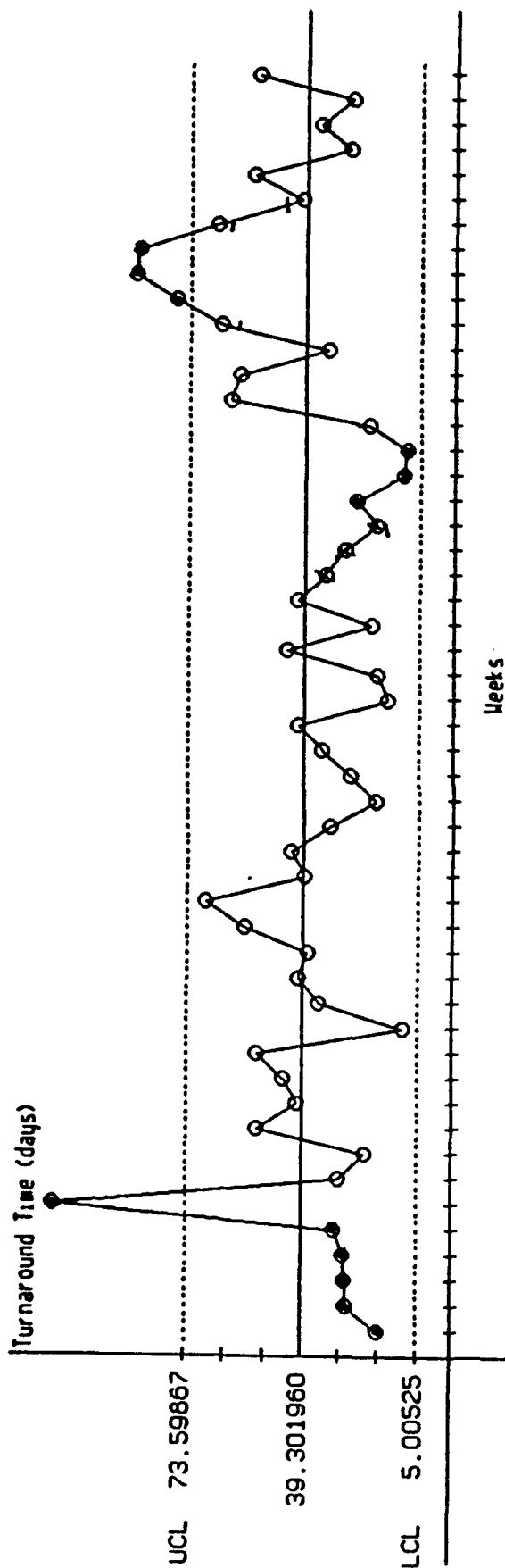
OEA WEEKLY SAMPLES RECEIVED 1991-1992 All Functions Combined (Total)

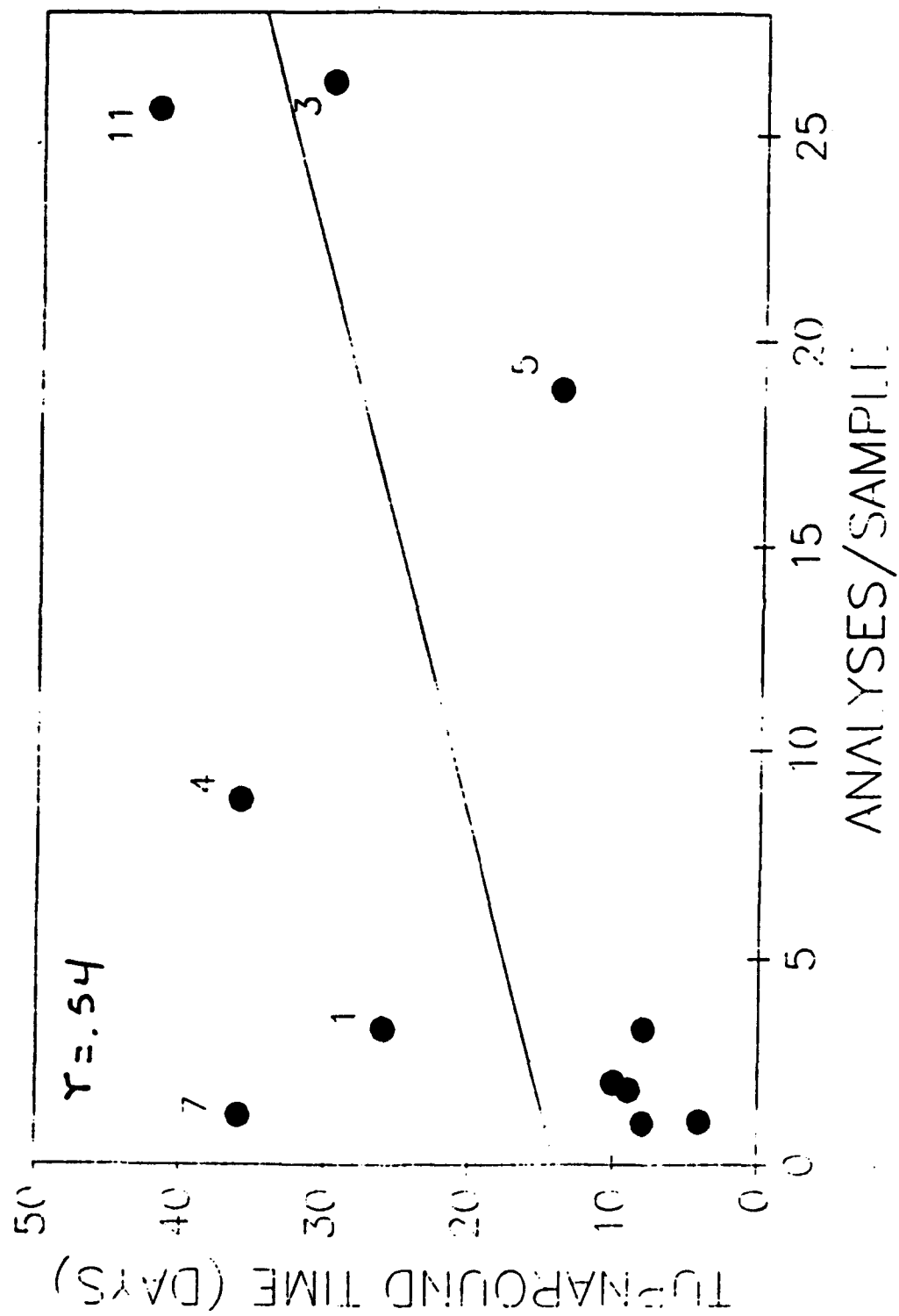


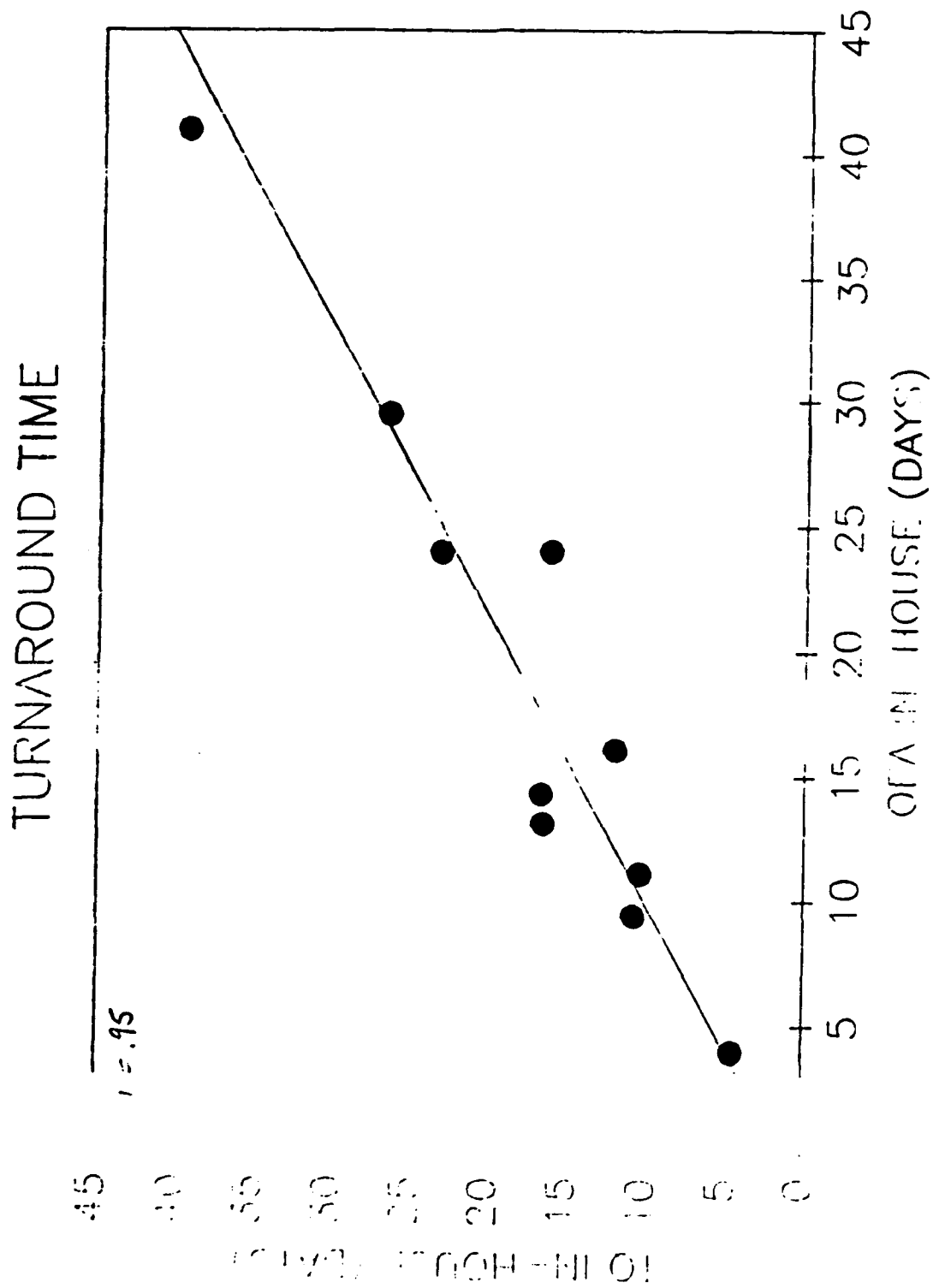
OEA WEEKLY TURNAROUND TIME Function 1: Metals (Total)

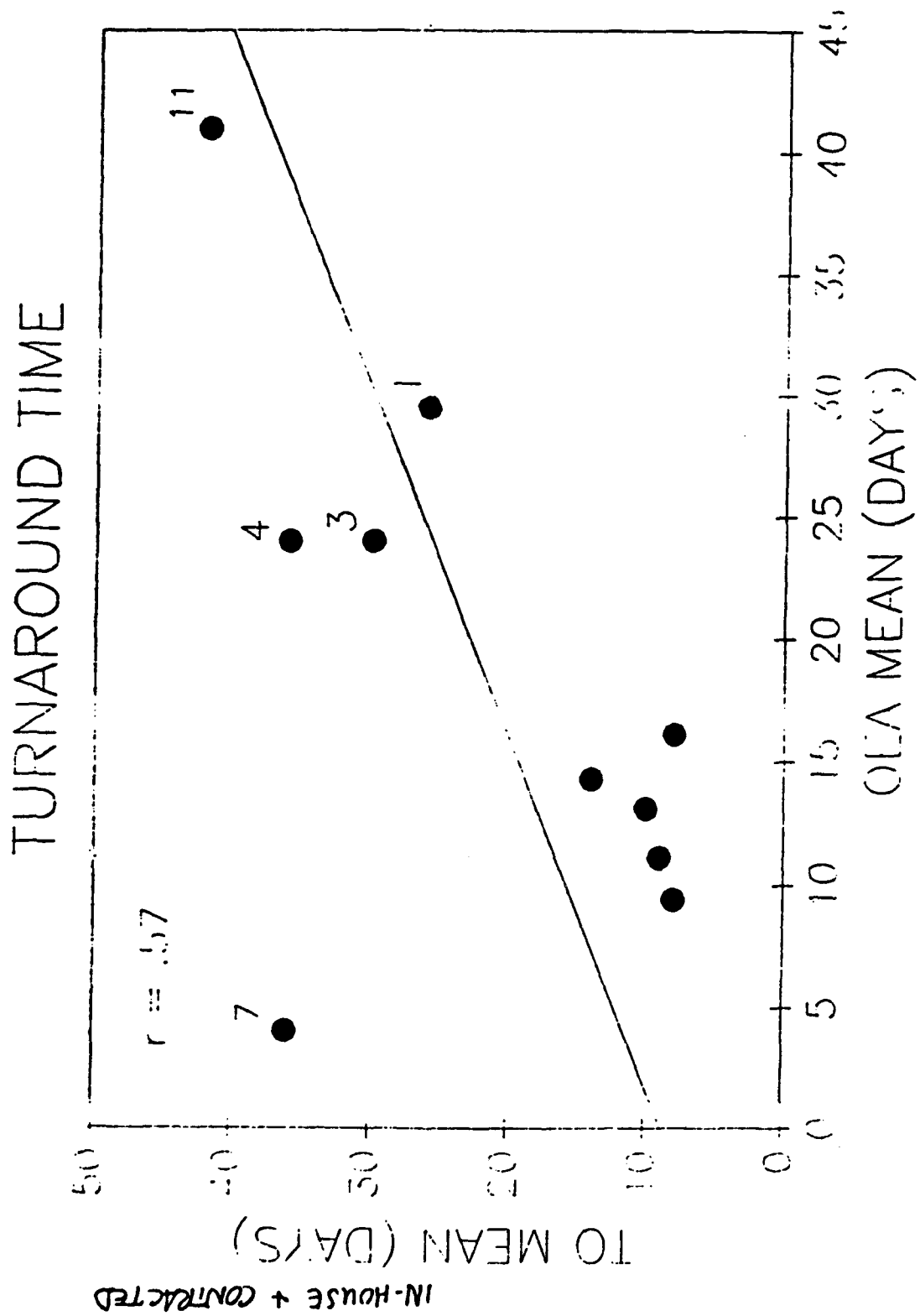


OEA WEEKLY TURNAROUND TIME Function 4: Pesticides (Total)









PARETO CHART OF ANALYSES PERFORMED BY 11 OEA FUNCTIONS

Jan 1992 thru June 1992

(top 3 per function)

<u>function</u>	<u># of analyses</u>	<u>total # for function</u>	<u>top 3 as % of fcn total</u>
1. HAZ/TOX *			
lead	1489		
chromium	1405		
cadmium	1378	45591	9.4 %
2. METALS			
lead	6603		
copper	2995		
chromium	2686	33861	36.3 %
3. PESTICIDES			
aroclor 1016	2245		
aroclor 1232	2244		
aroclor 1242	2244	34958	19.3 %
4. AIR ASBESTOS			
asbestos	2550		
fiberglass	2		
TEM analysis	1	2553	100. %
5. BULK ASBESTOS			
asbestos	2033		
chrysolite asbestos	230		
amosite asbestos	85	2362	99.4 %
6. INORGANICS			
oil and grease	1900		
chem oxygen demand	1047		
phenol	1027	16120	21.9 %
7. VOLATILE ORGANICS *			
1,4-dichlorobenzene	1588		
chlorobenzene	1510		
1,2-dichlorobenzene	1498	55971	8.2 %
8. AIR PARTICULATES			
nuisance partic.	1021		
silica	52		
carbon black	48	1193	94.0 %
9. INDUSTRIAL HYGIENE			
naphthal	848		
benzene	647		
toluene	599	8152	25.7 %
10. COMMERCIAL PRODUCTS			
major components	179		
carbon dioxide	52		
acetylene	45	767	36.0 %
11. GC/MS *			
1,3-dichlorobenzene	337		
1,2-dichlorobenzene	337		
1,4-dichlorobenzene	337	20693	4.9 %
GRAND TOTAL	41262	224221	18.4 %

* sample size much smaller than desirable using only top 3 analysis per function

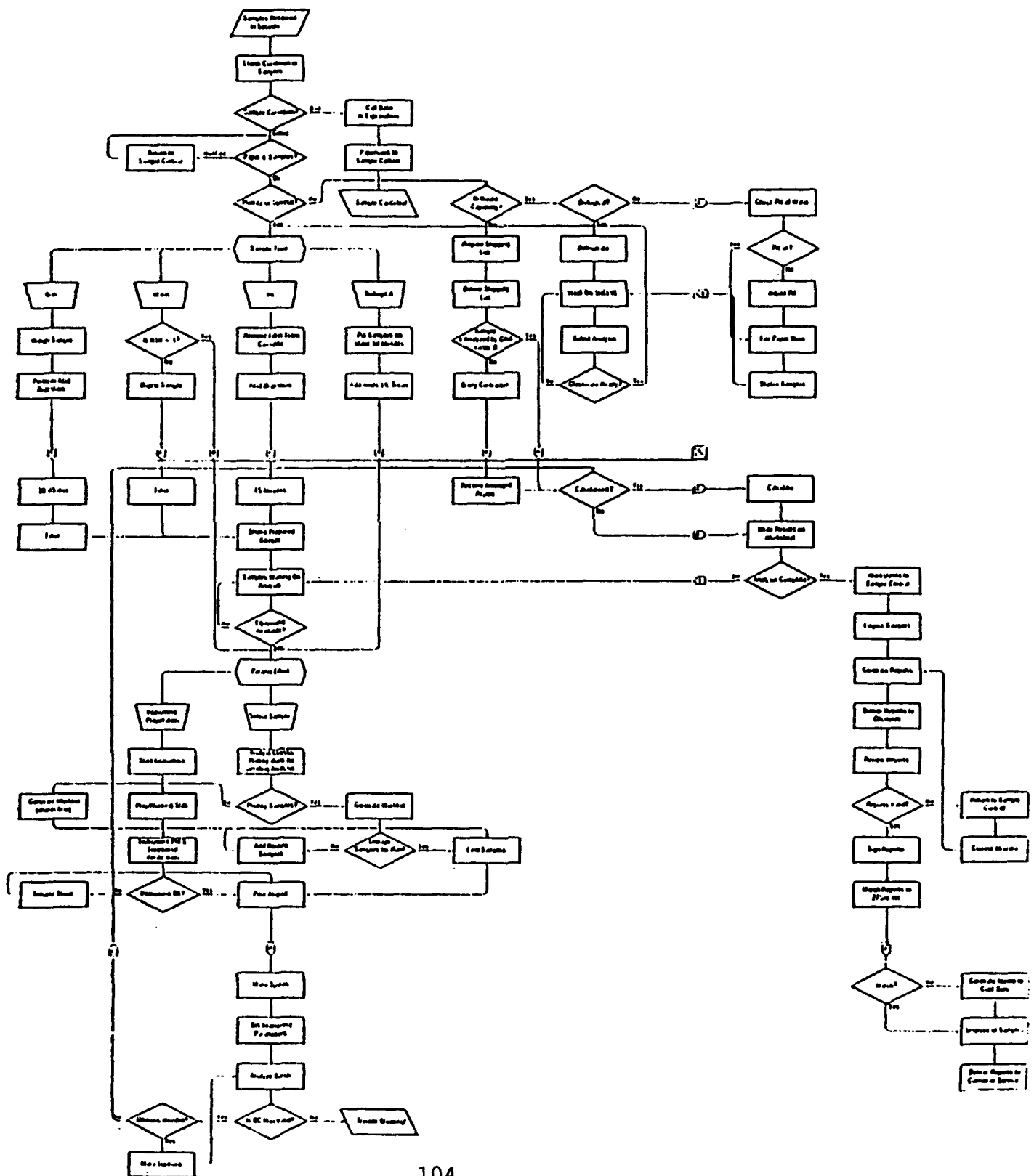
Attachment 3.1A - Tools Used To Analyze The Process

When Prepared: Metals Function Flow Chart-Oct/Nov 92
Customer Service Flow Chart-Oct/Nov 92
Pesticide Analysis Flow Chart-Jan 93
Sample Process Flow Chart-Jul 92

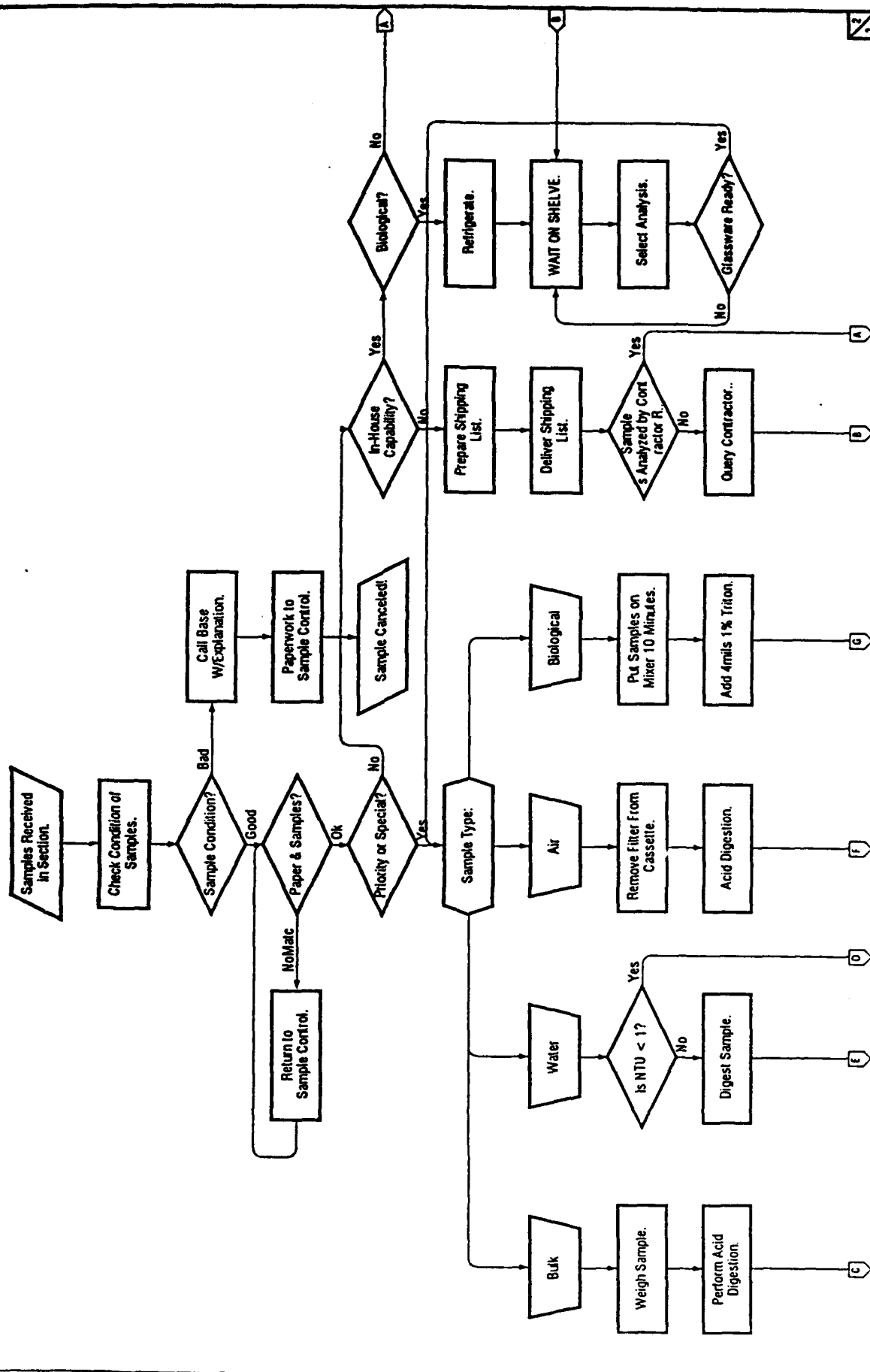
Need/Purpose: To educate team members on processes being studied and for identification of bottlenecks.

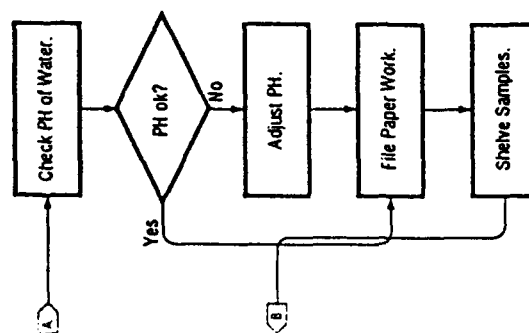
How: The team made a detailed tour of these functions. The flow charts were then developed by utilizing expertise from the functional areas being studied and by group brainstorming.

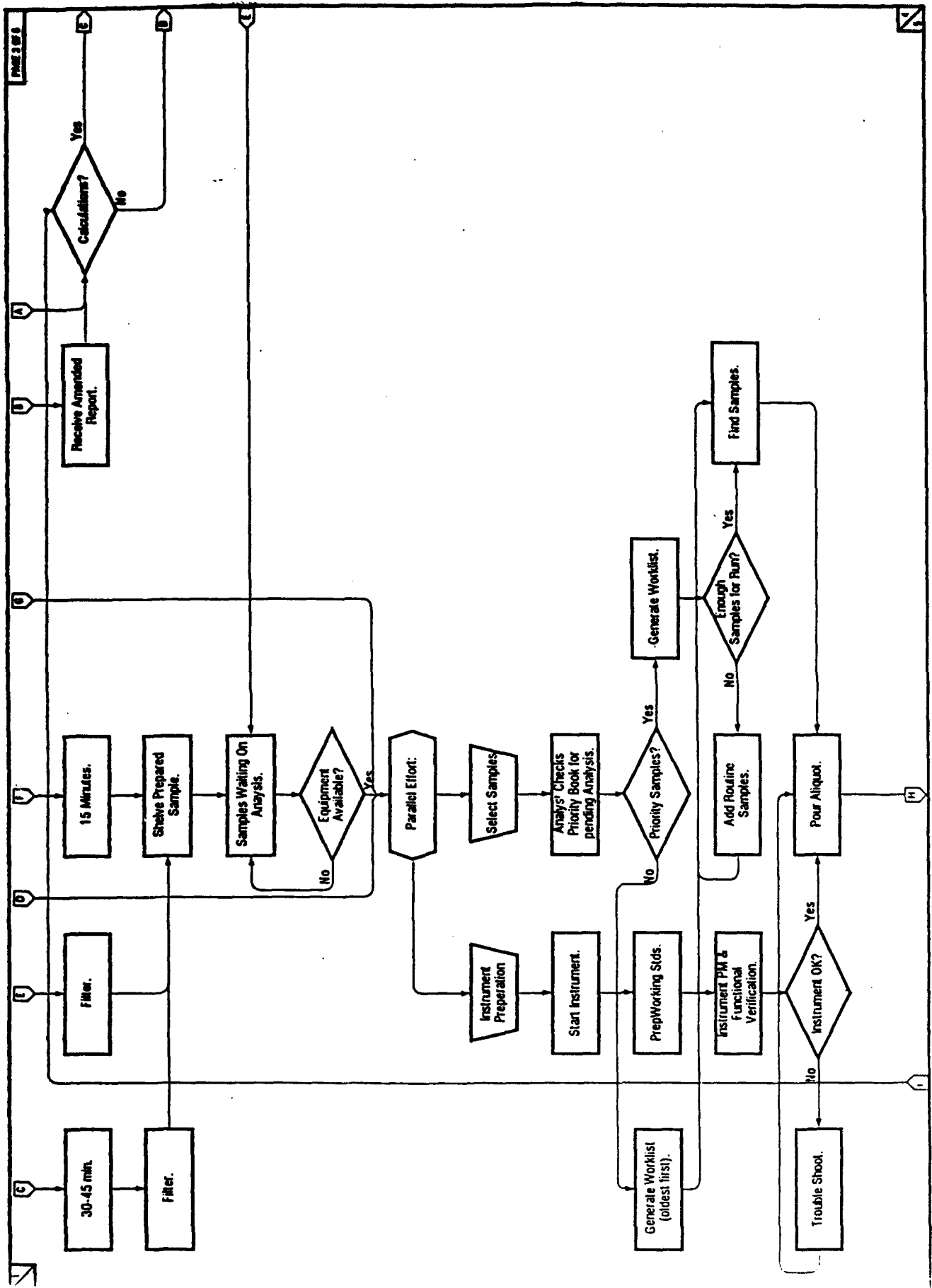
FLOW CHARTING OF METAL ANALYSIS FUNCTION PROCESS

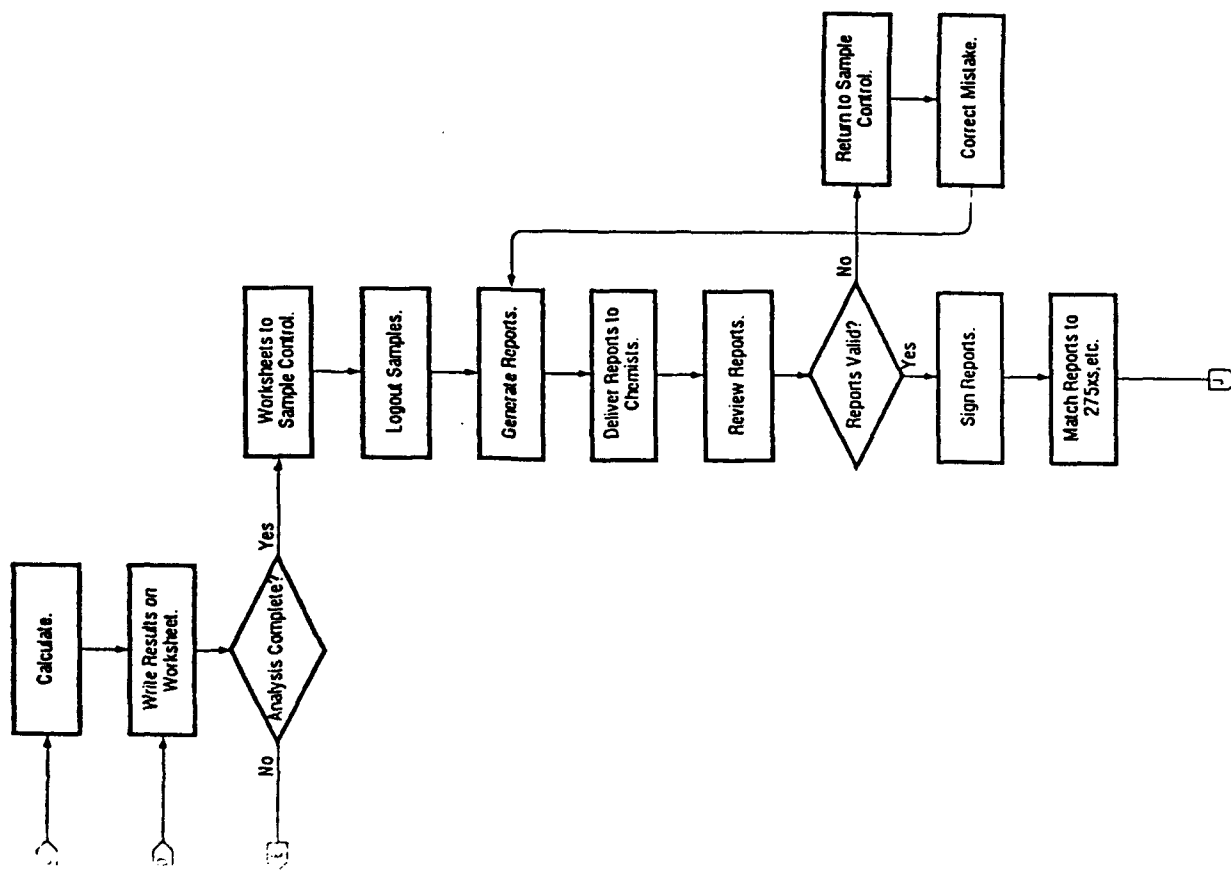


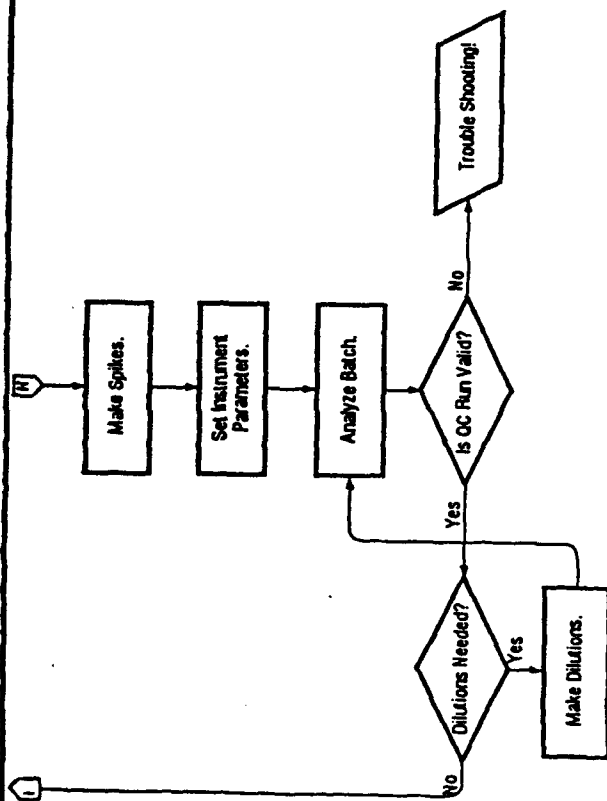
METALS (Rev 13 Nov 92)

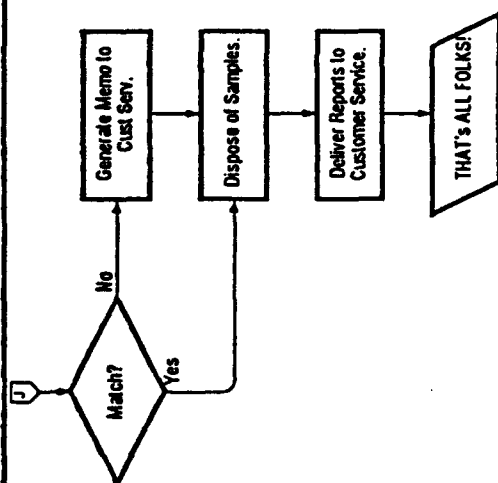




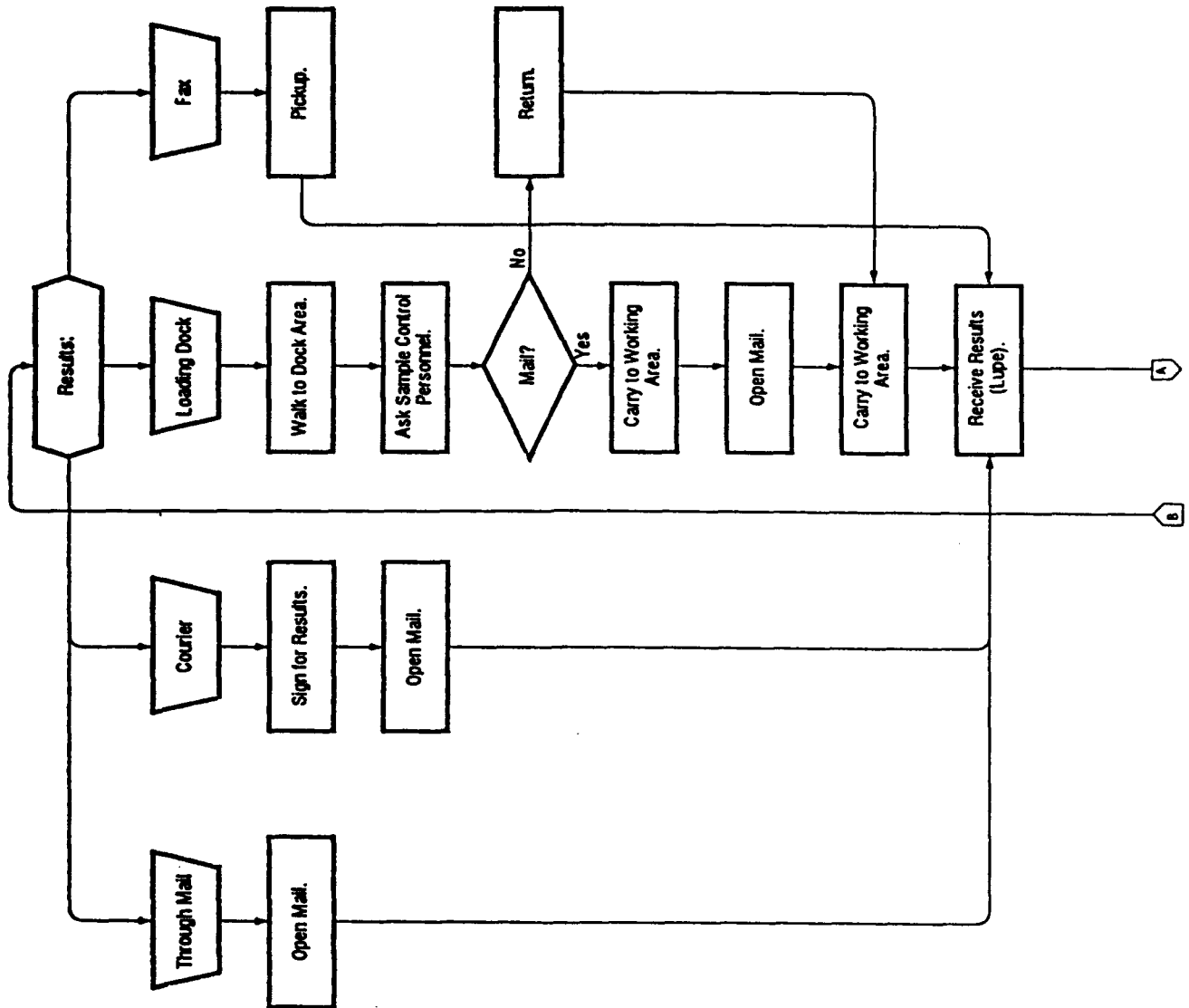


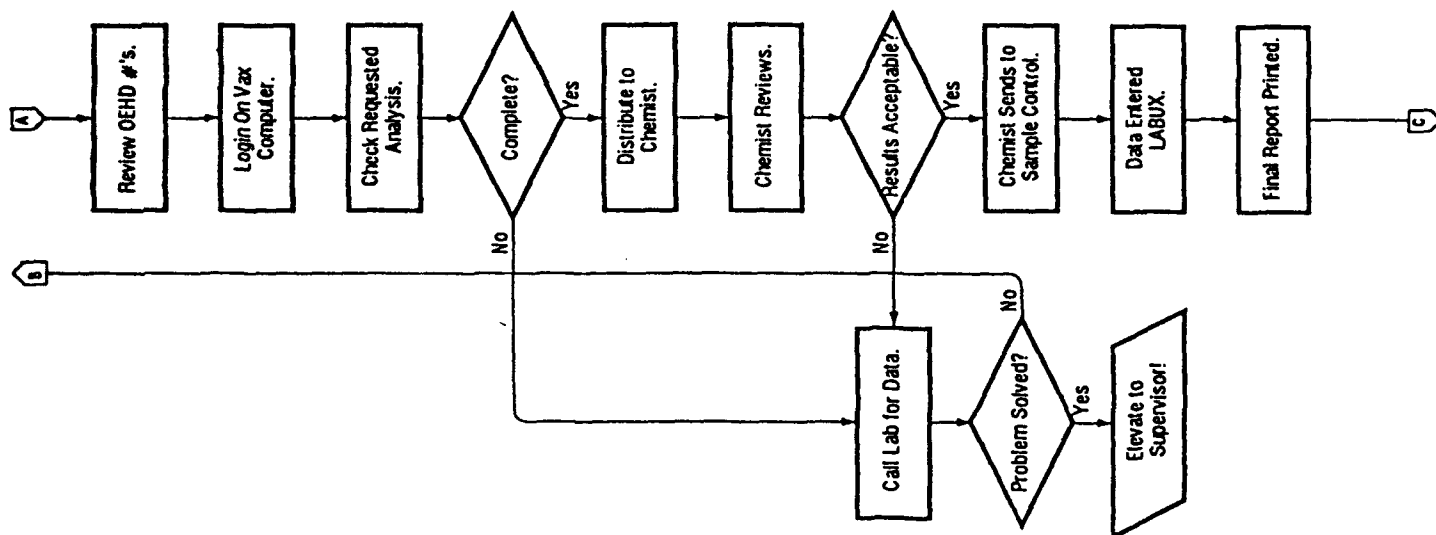


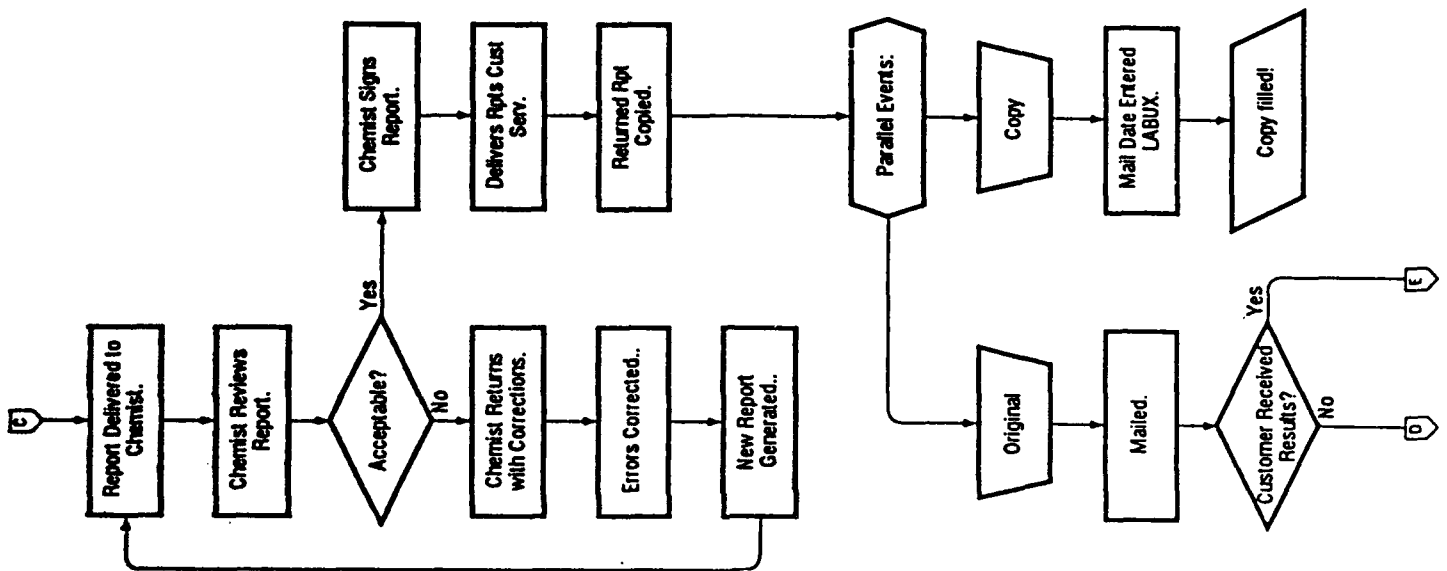


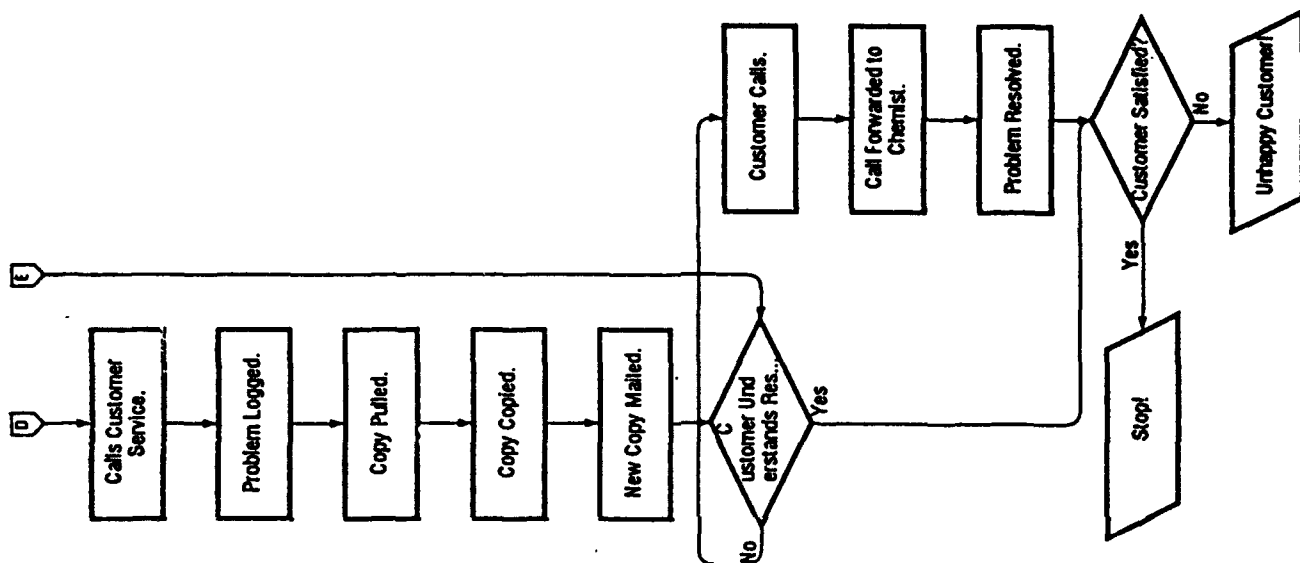


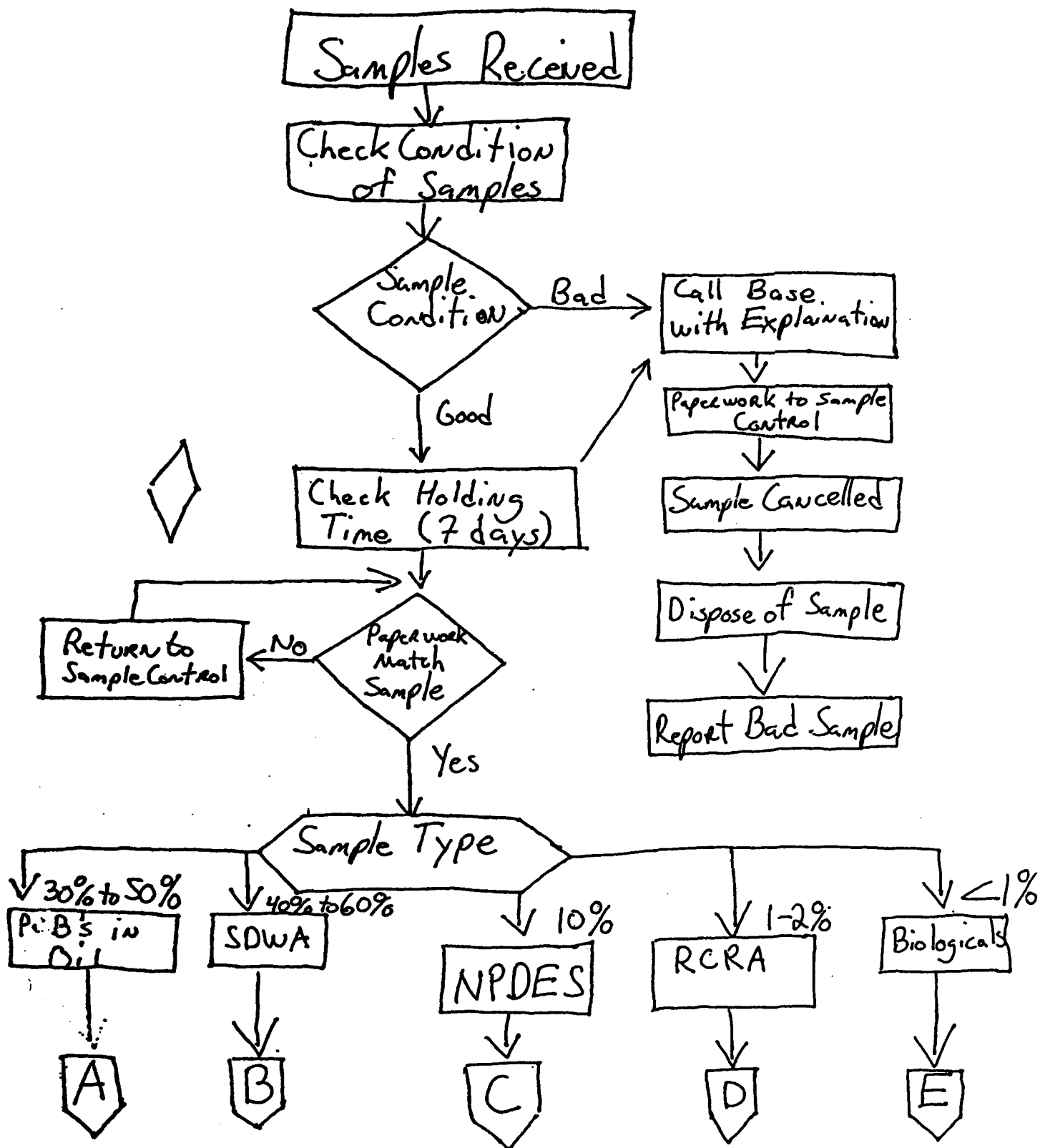
CONTRACT LAB RESULTS (Rev 13 Nov 92)

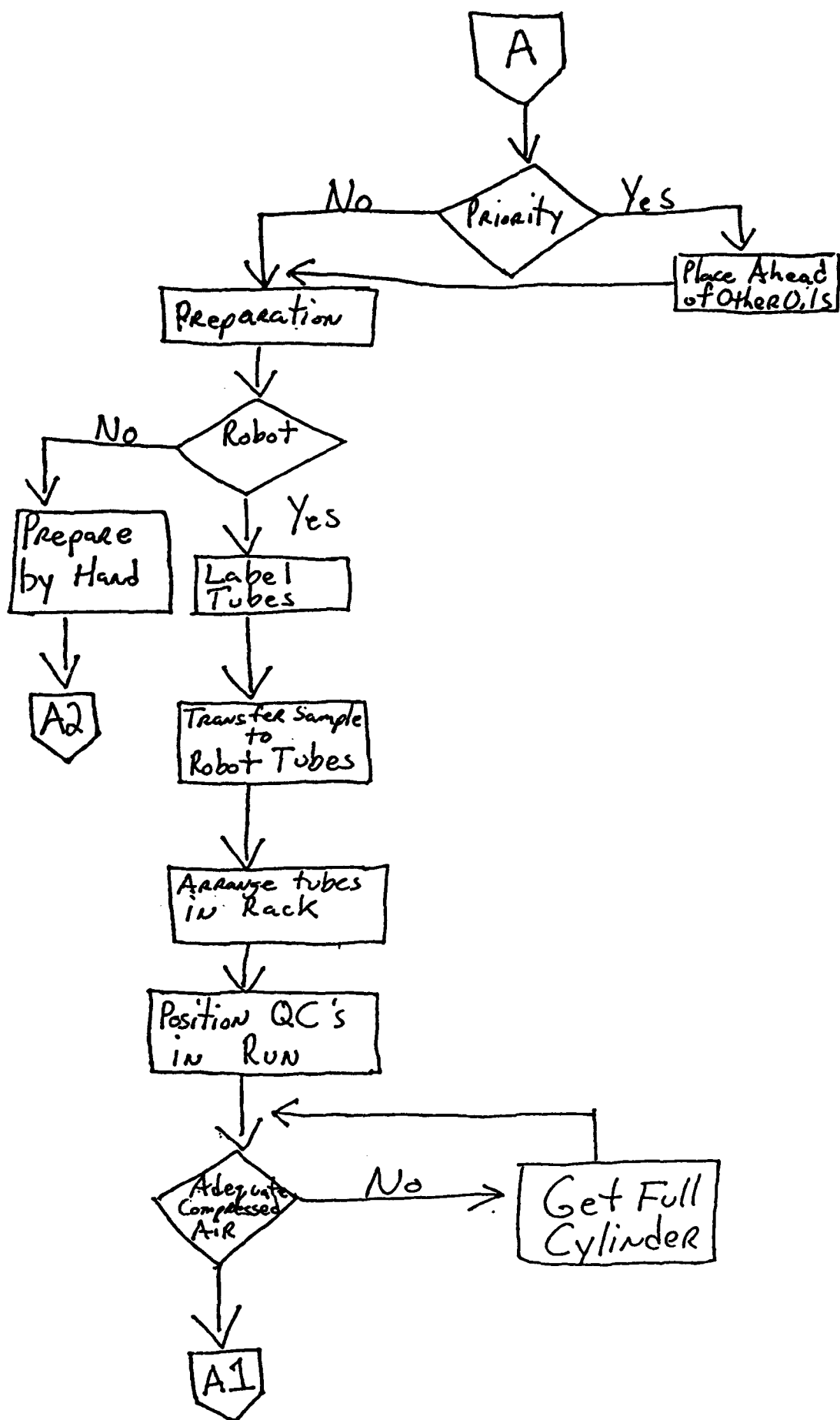


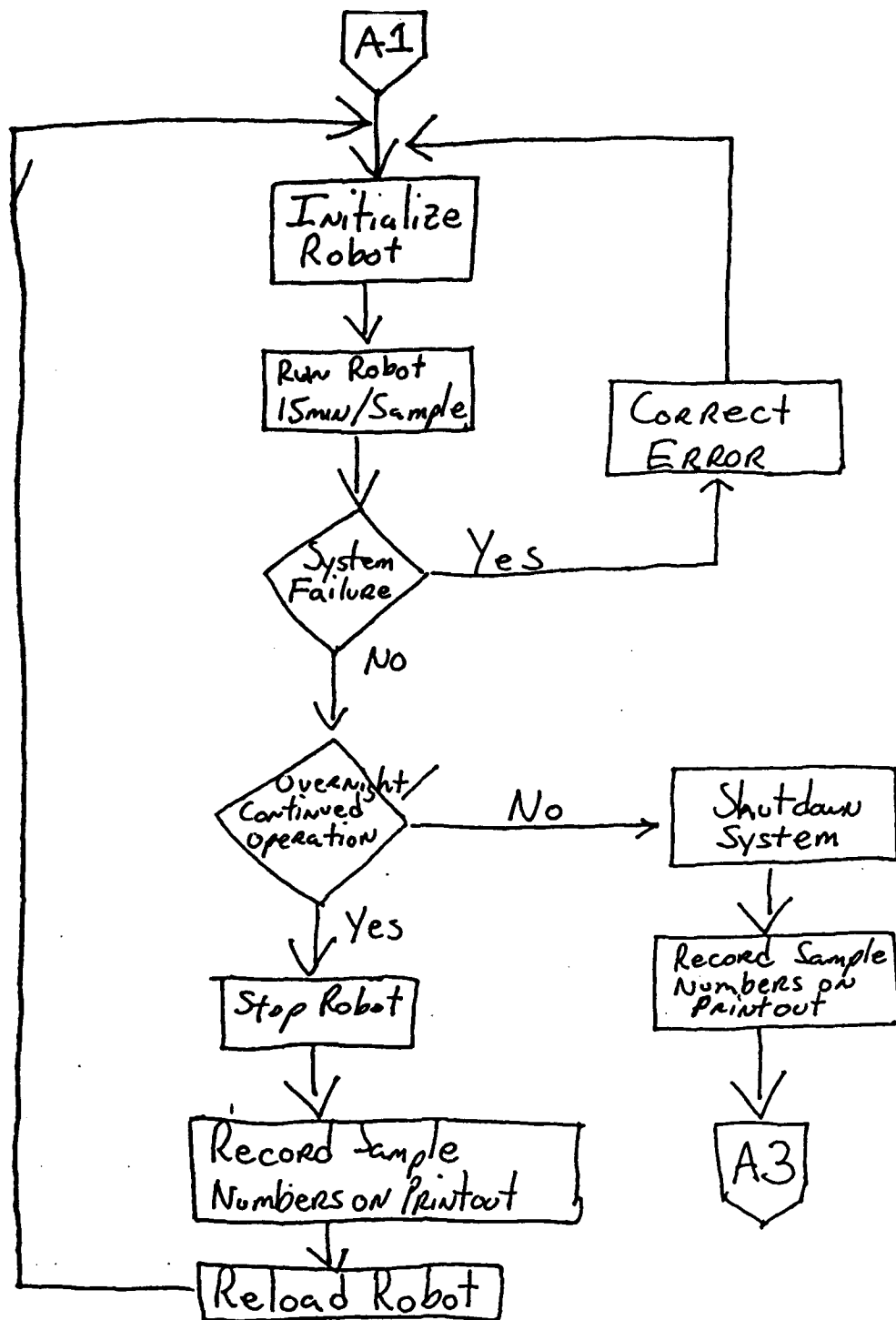


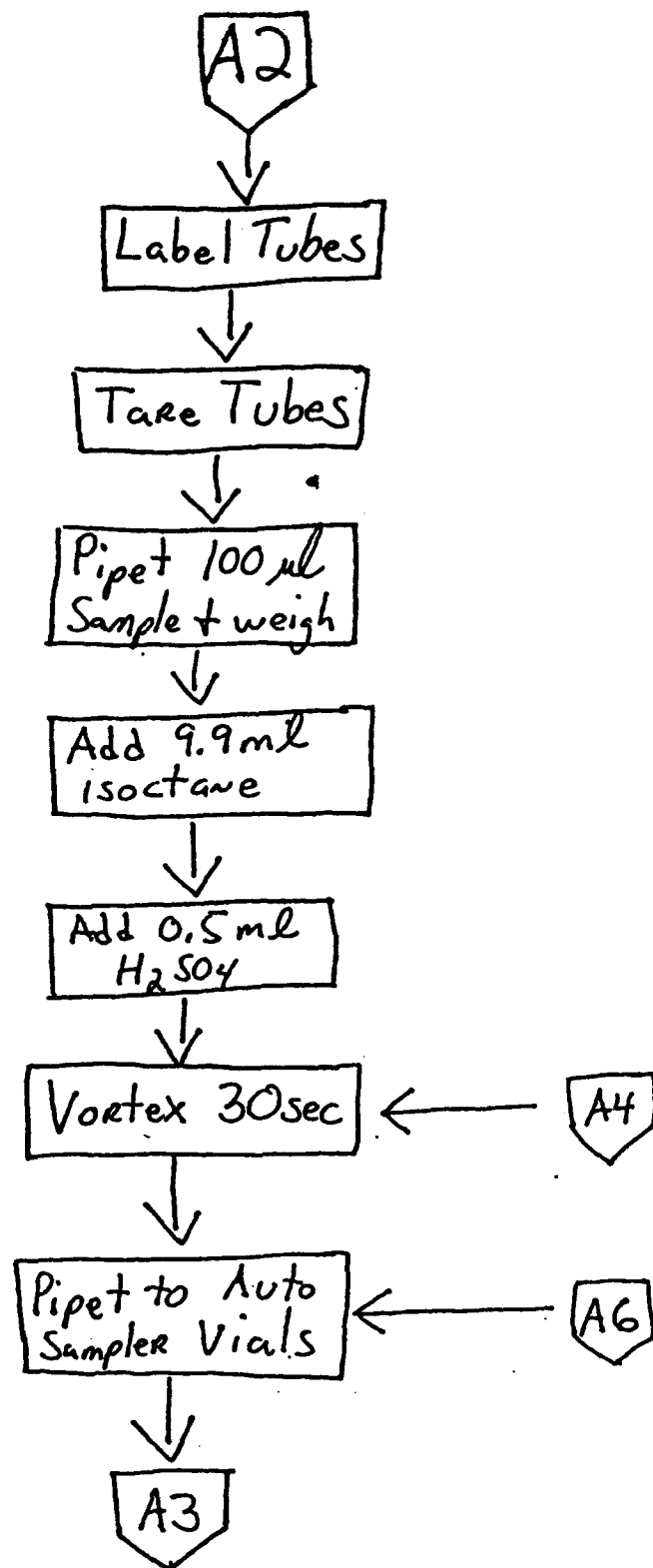


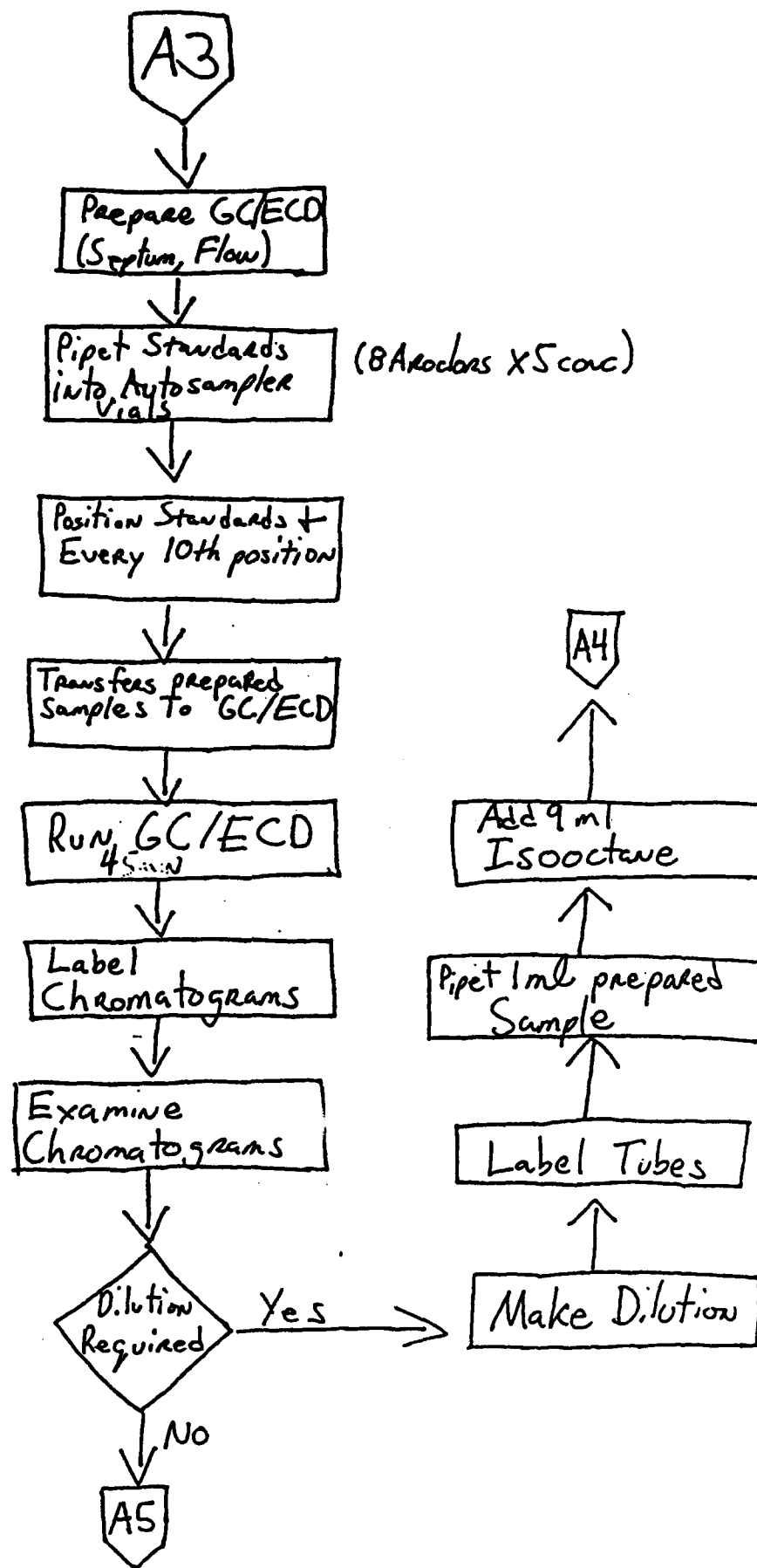


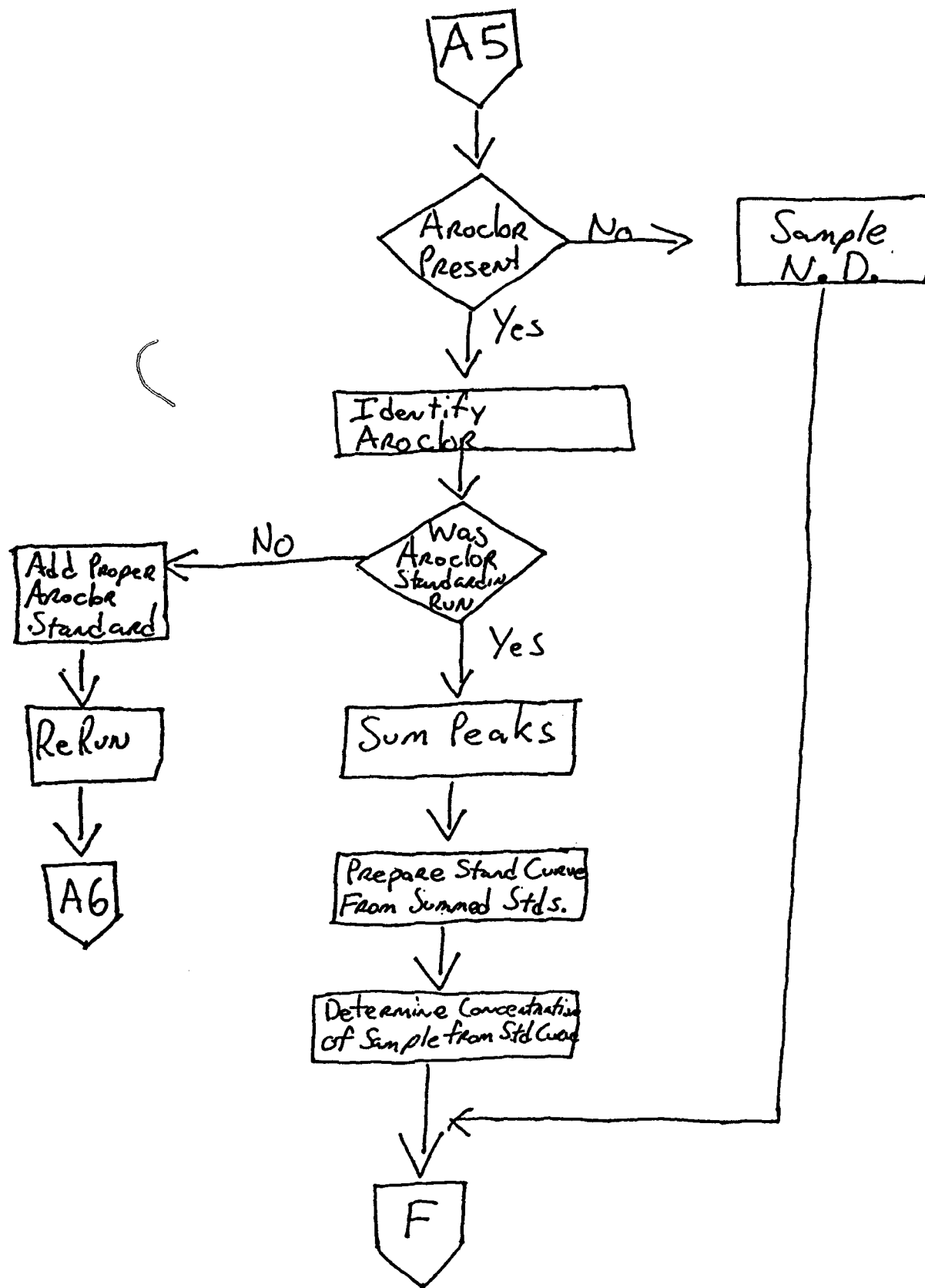


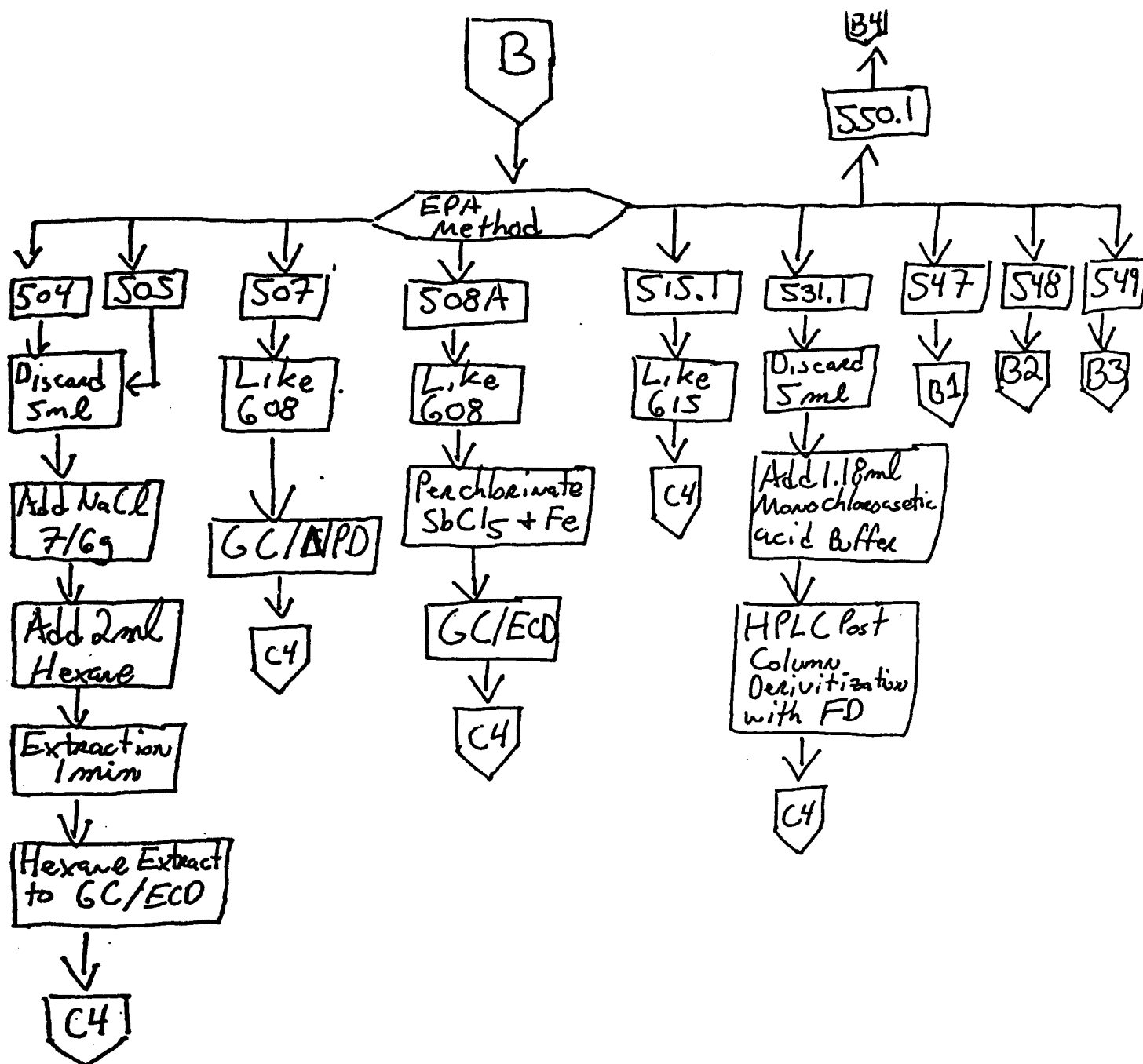






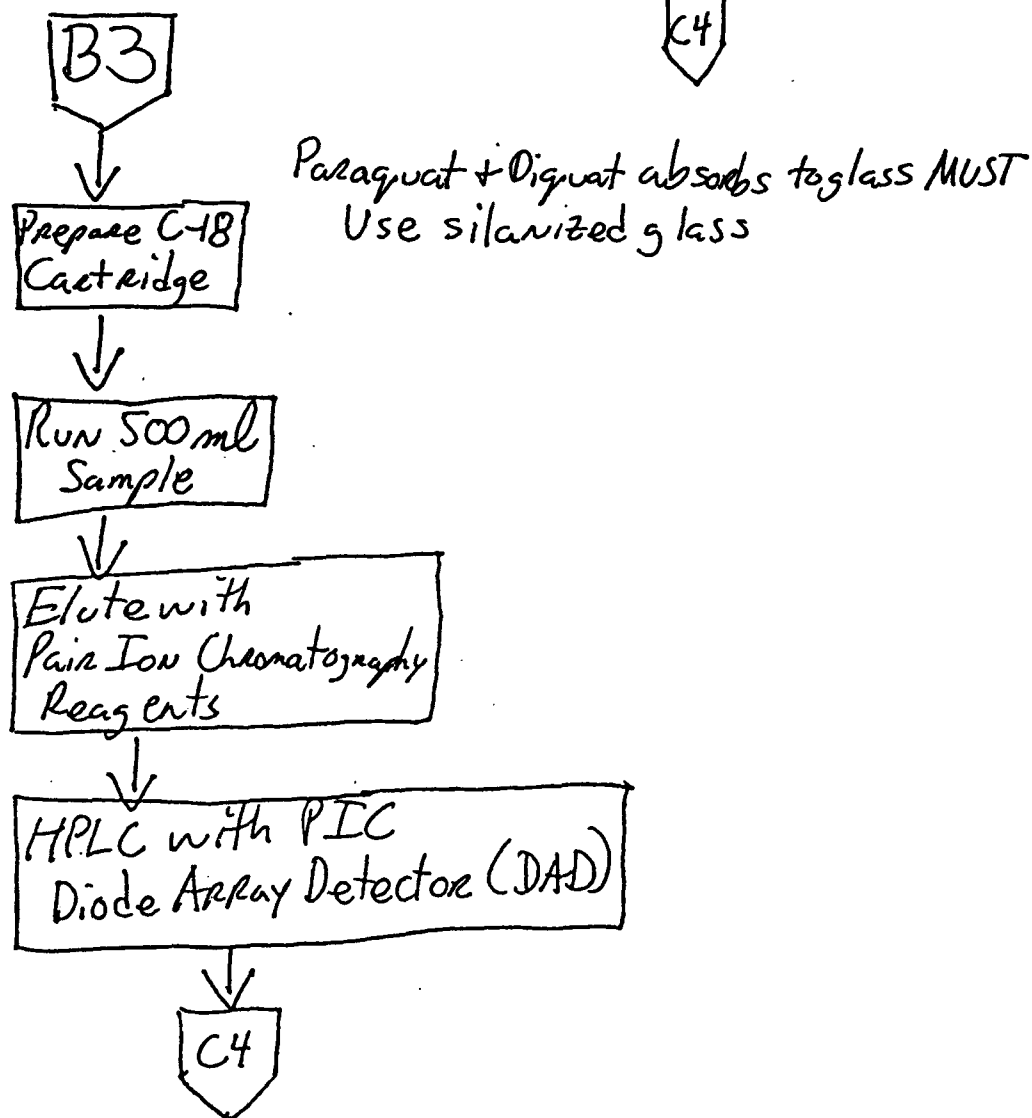
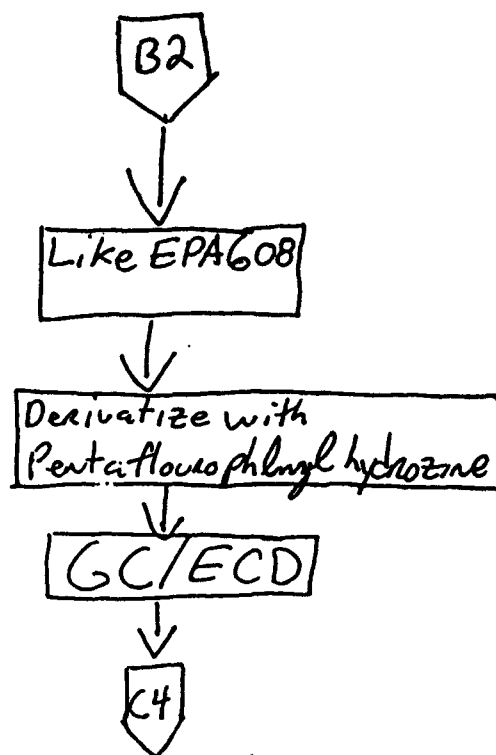
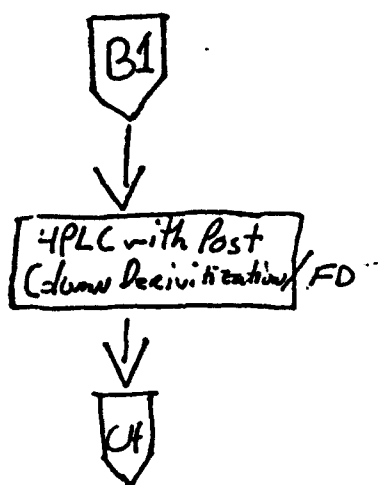


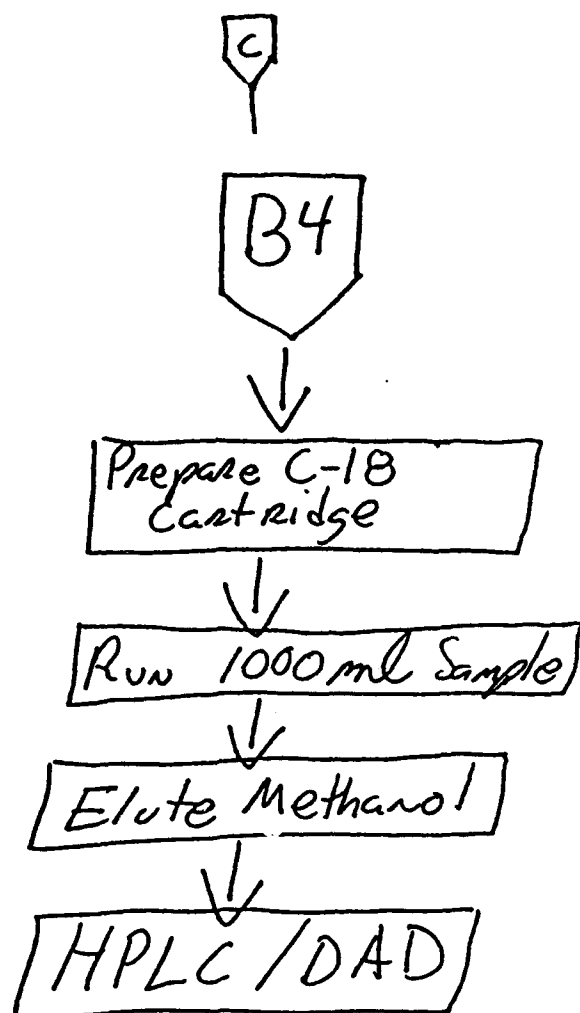


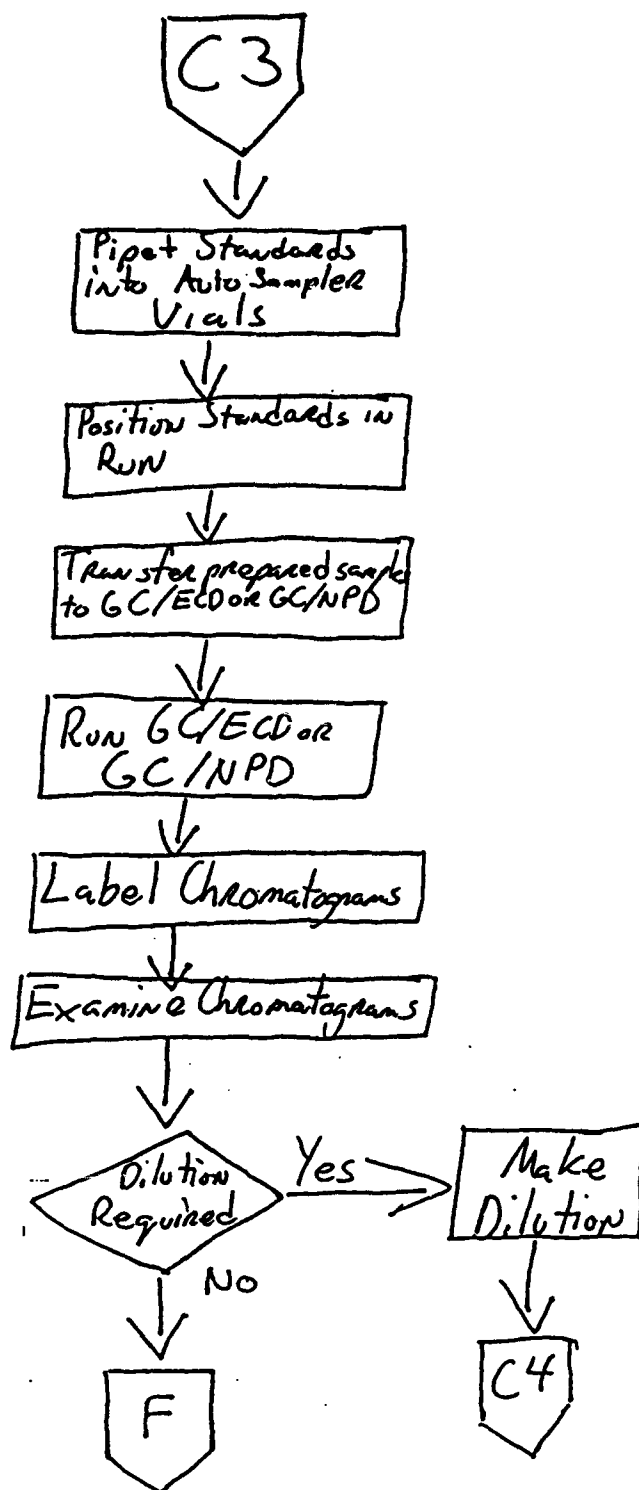


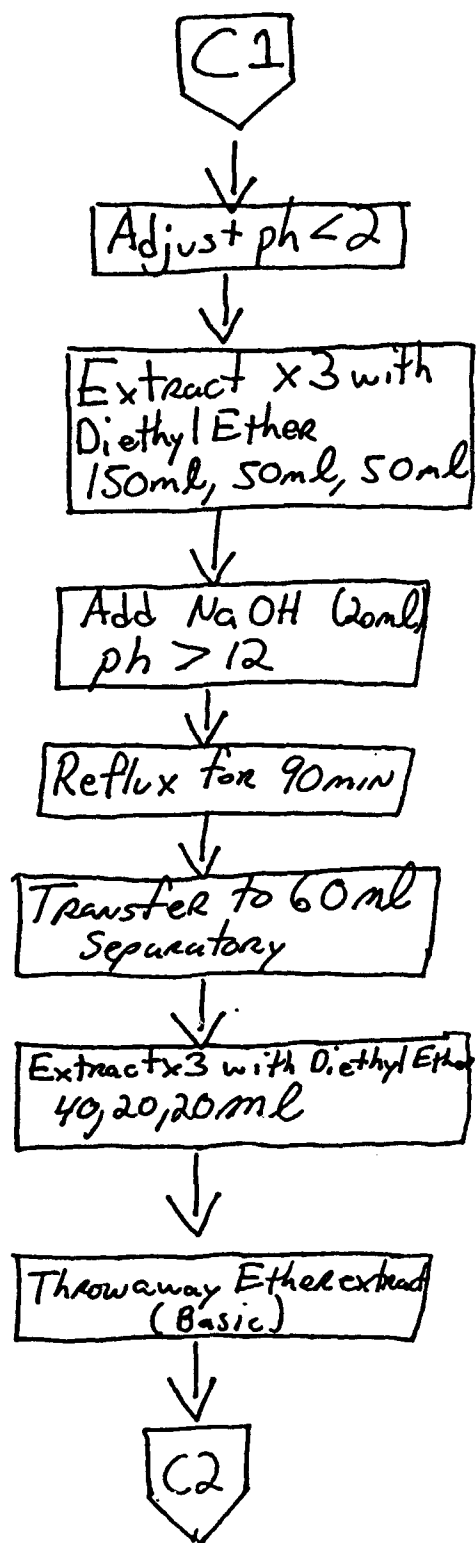
Robt Fiscal 94?

* SbCl_5 = Antimony Penta Chloride

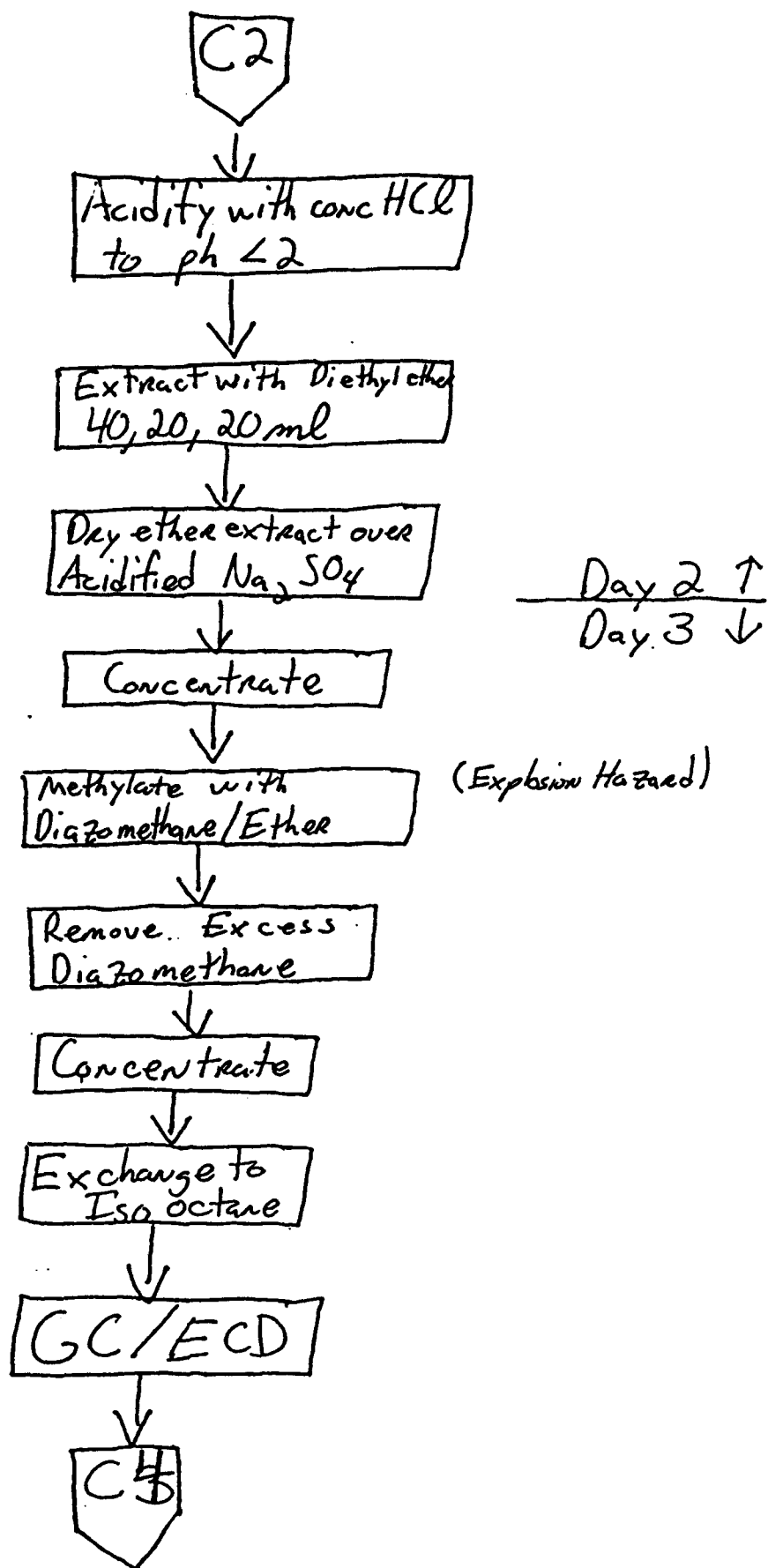


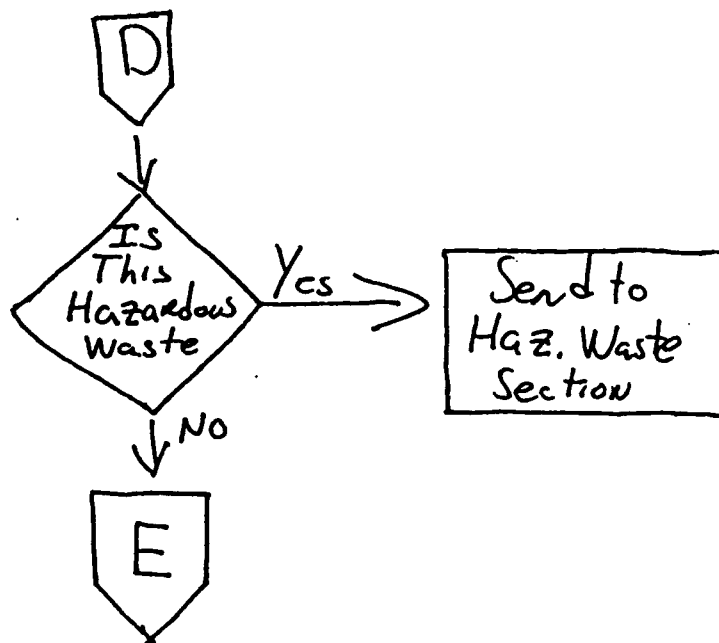


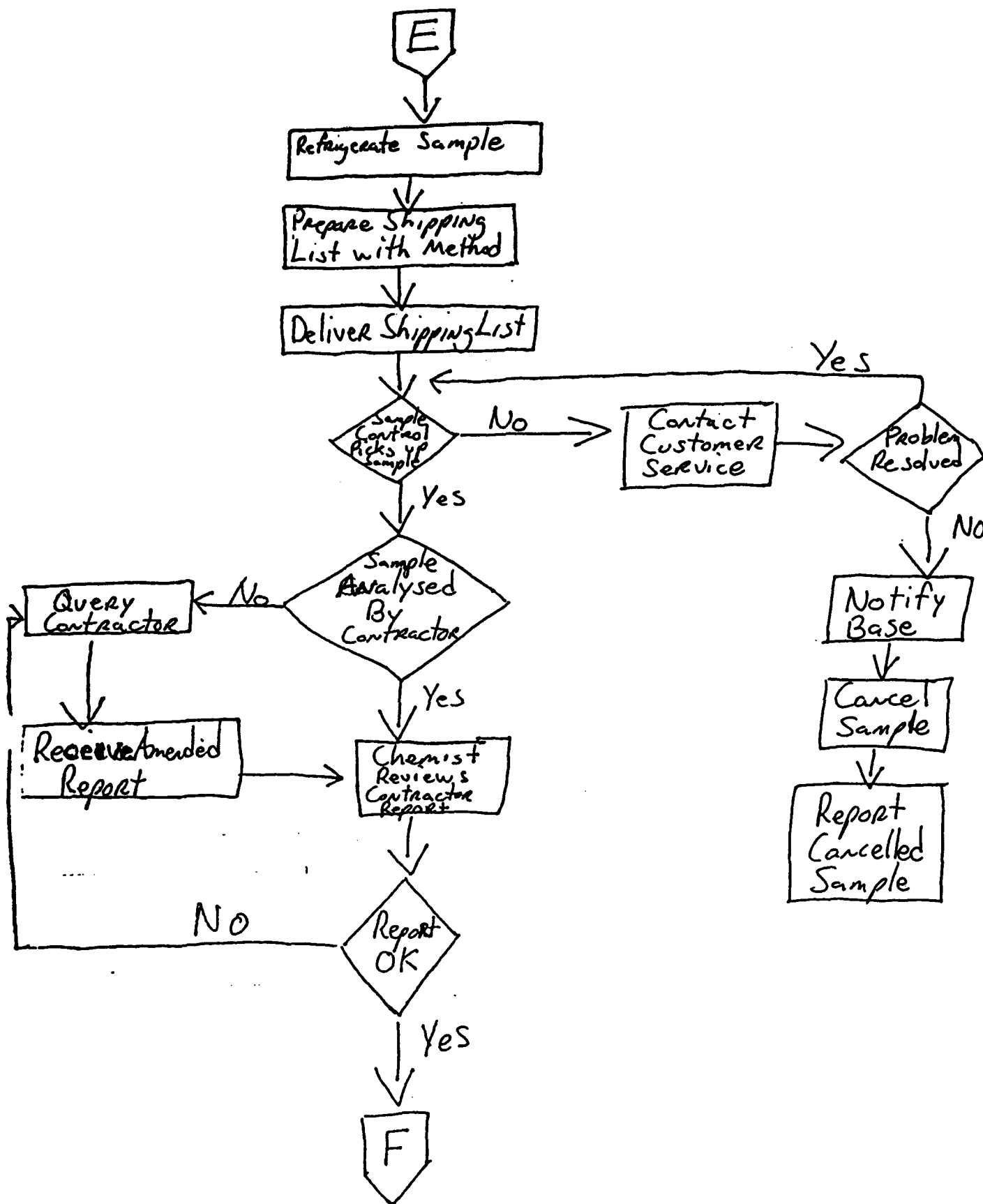


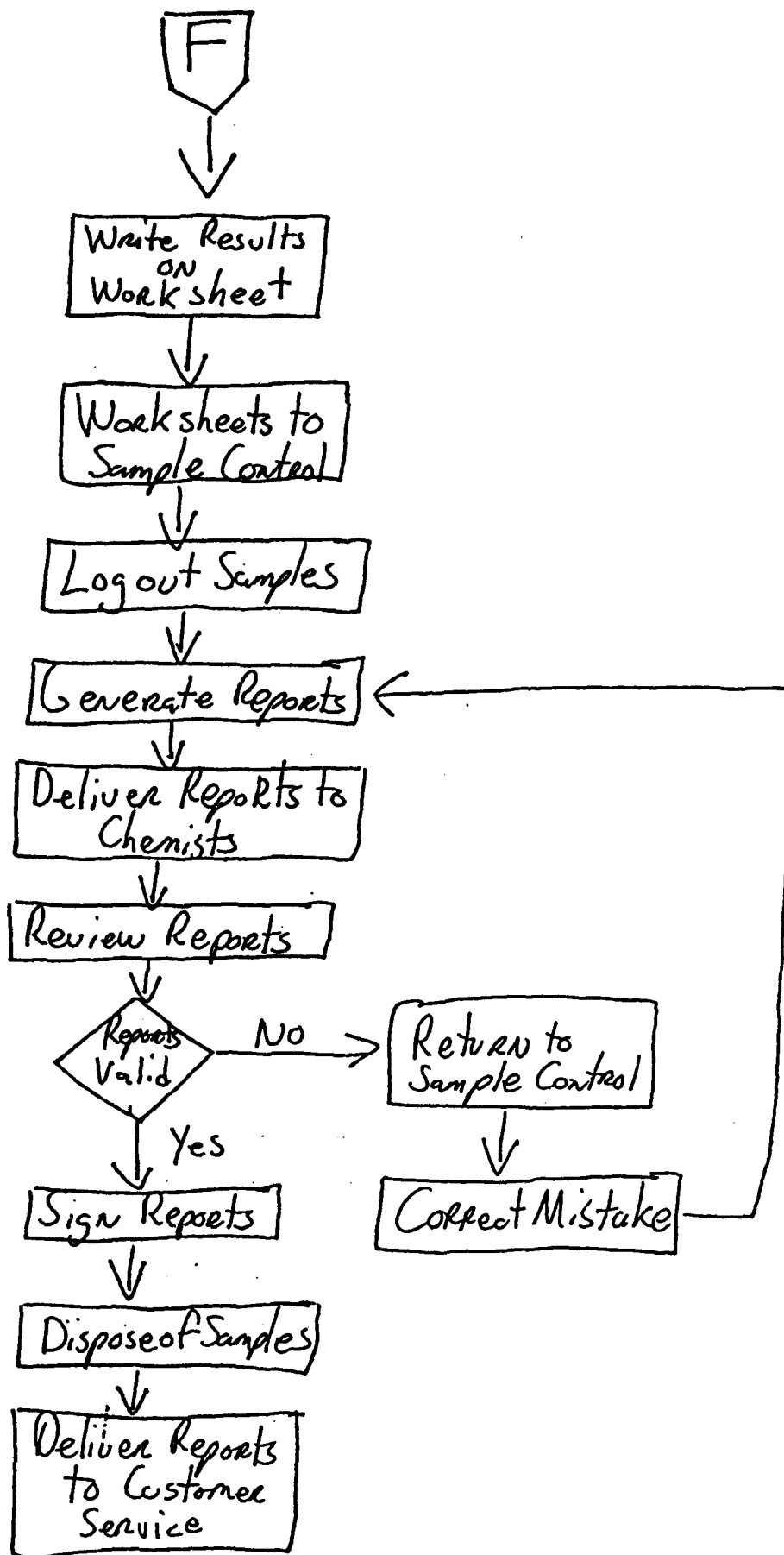


Day 1 ↑
Day 2 ↓

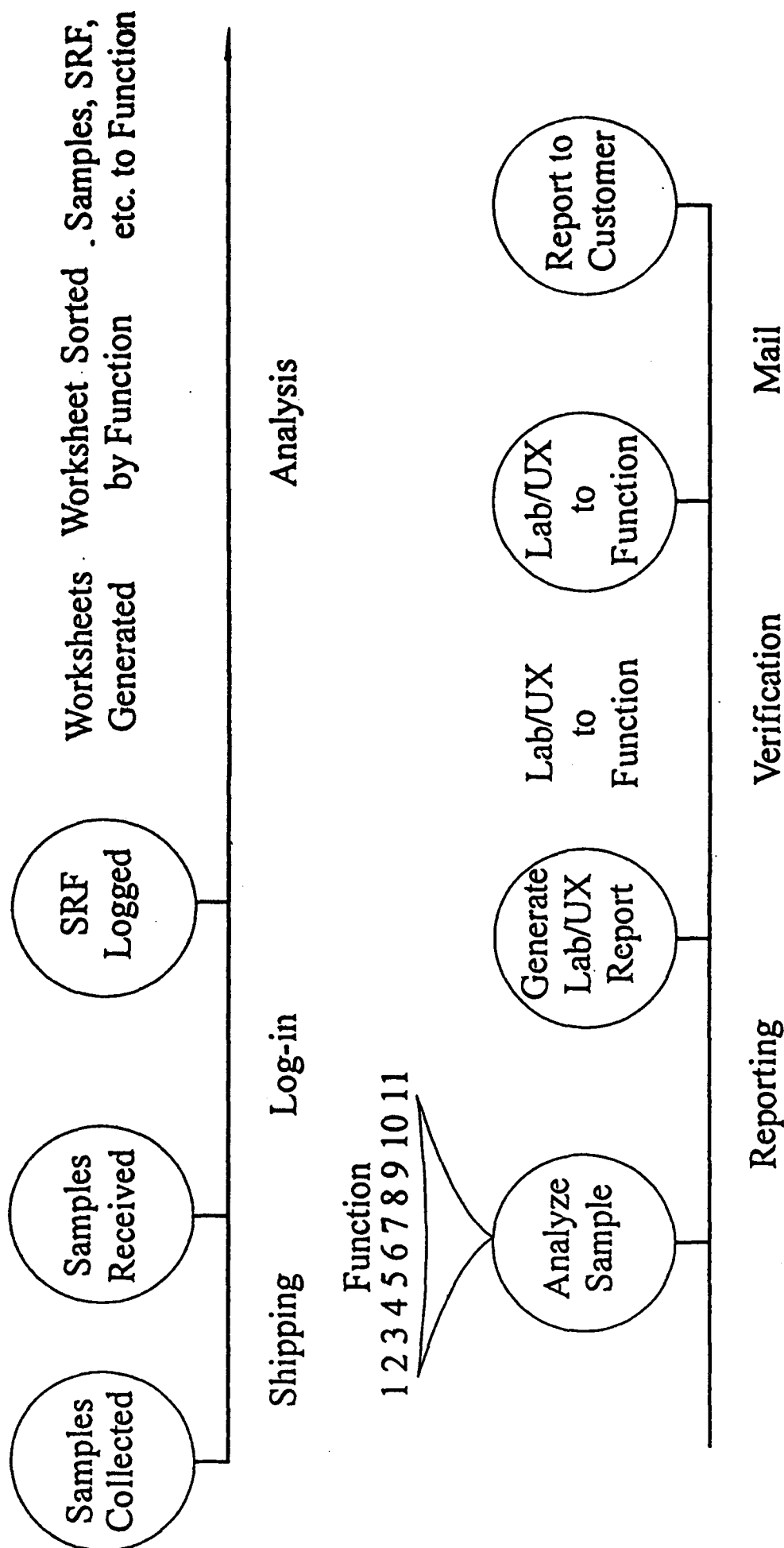








PROCESS STEPS



Attachment 3.2A - Process Performance Baseline

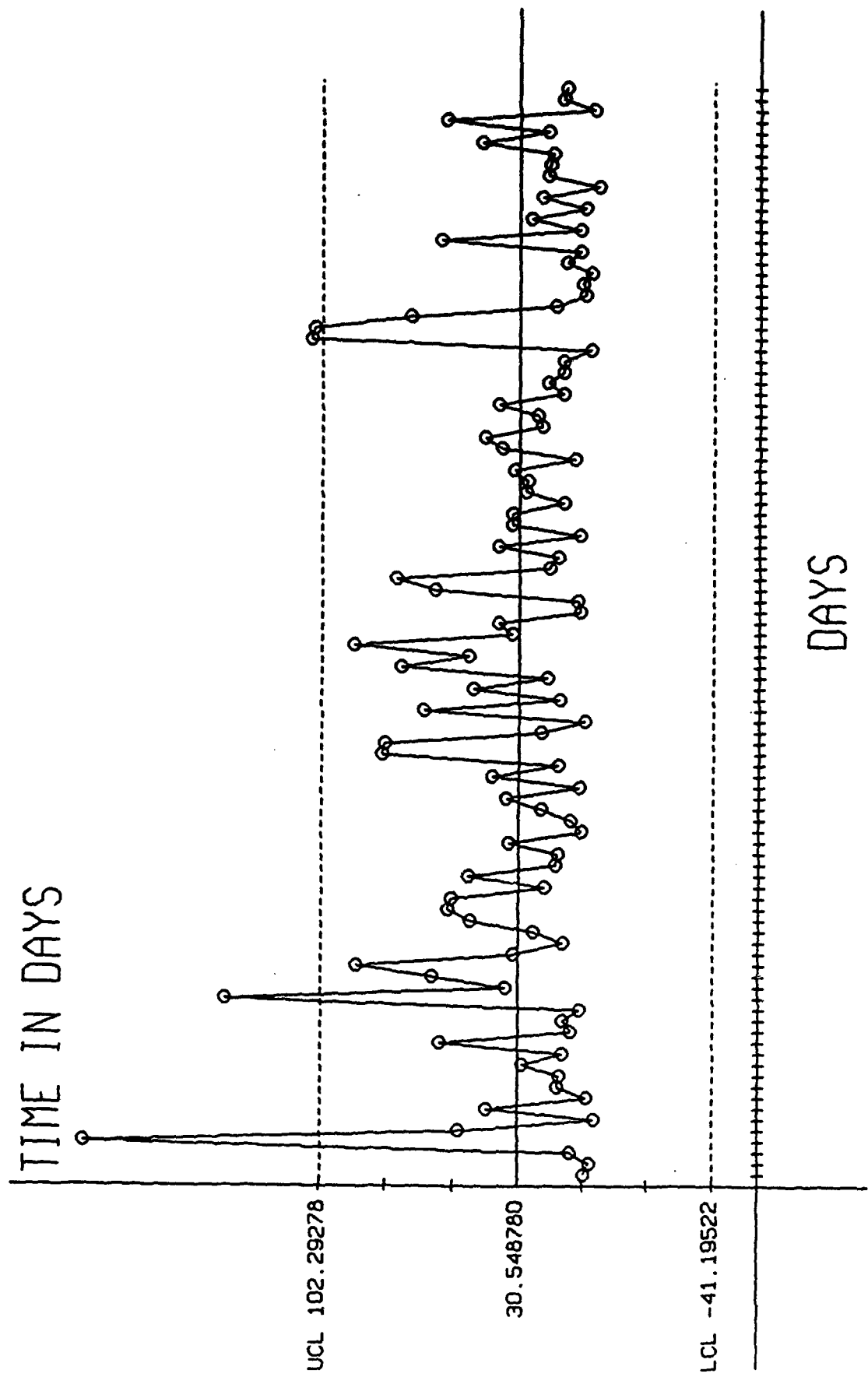
When Prepared: Turnaround Time Control Charts -
Sep/Oct 92
Samples Received Control Chart-
Sep/Oct 92

Need/Purpose: To establish a baseline as a reference point
for determining process improvement.

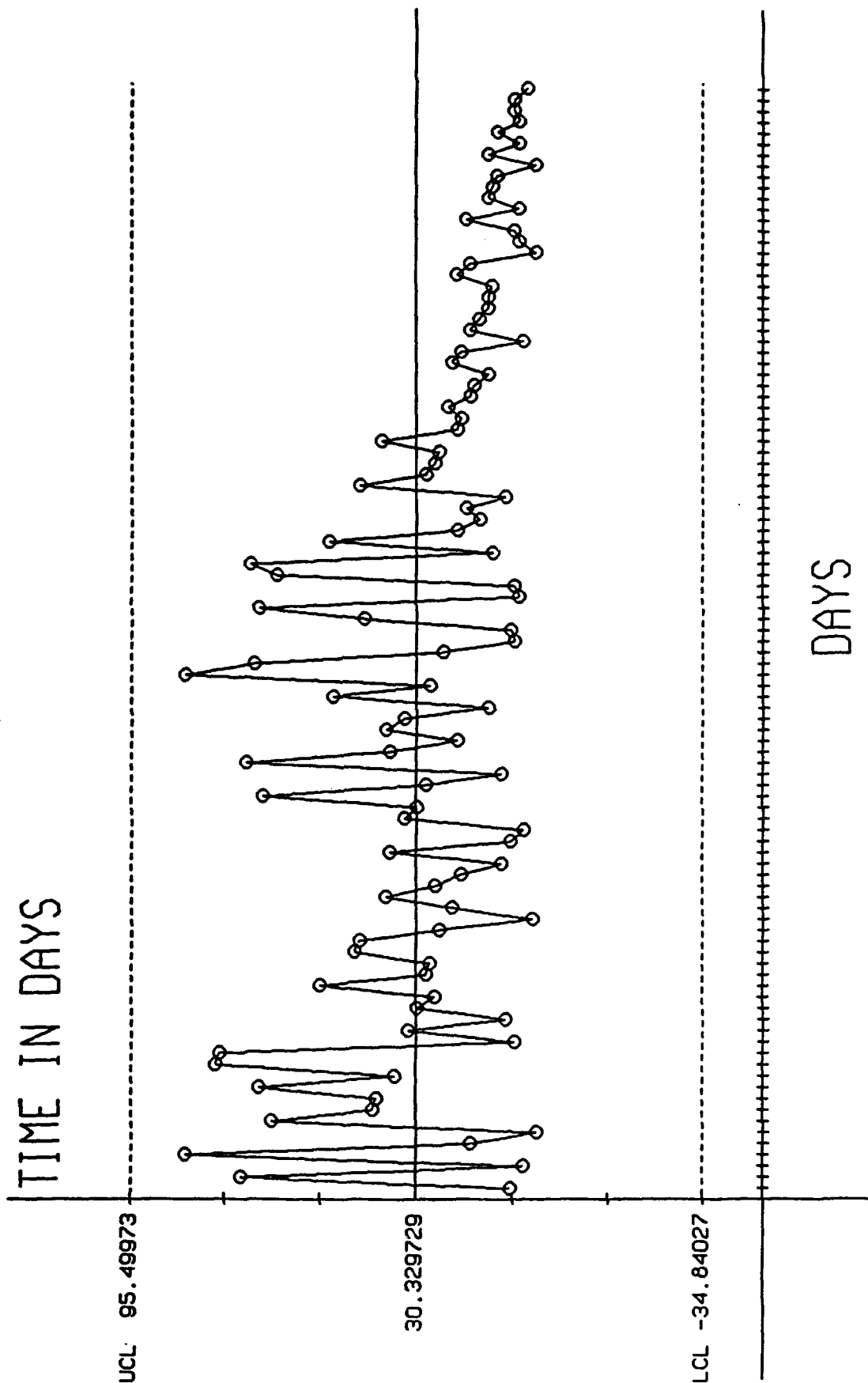
How: The charts were developed using data obtained from
the Analytical Services Division sample database

Make Note Of: Charts are \bar{x} and r

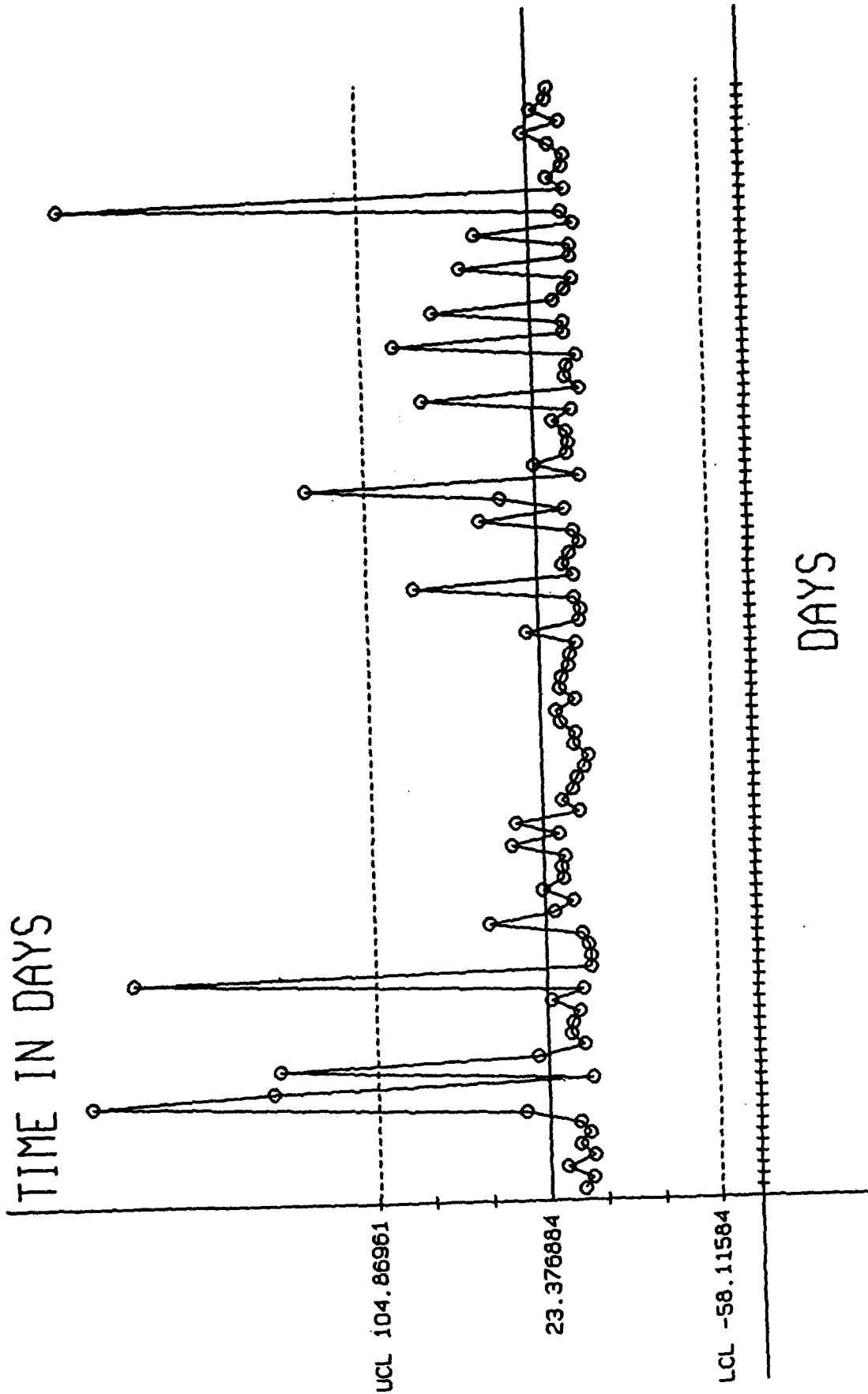
INHOUSE TURN AROUND TIME FOR SECTION 01 FOR 91



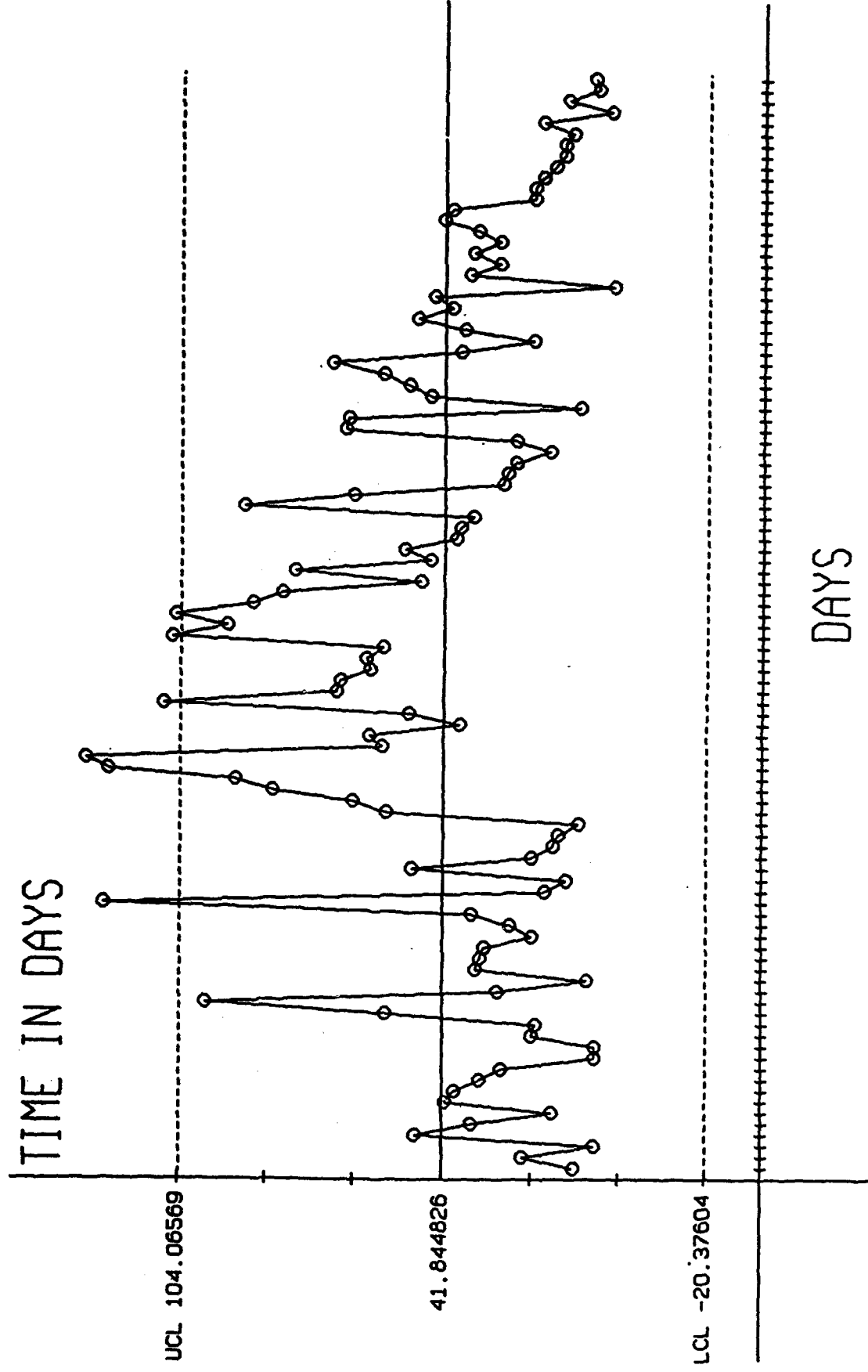
INHOUSE TURN AROUND TIME FOR SECTION 01 FOR 92



INHOUSE TURN AROUND TIME FOR SECTION 04 FOR 91



INHOUSE TURN AROUND TIME FOR SECTION 04 FOR 92



Attachment 3.3A - Identification of Potential Areas for Process Improvement

When Prepared: Fishbone Diagram - Dec 92/Jan 93
Laboratory Visit Findings-Feb 93

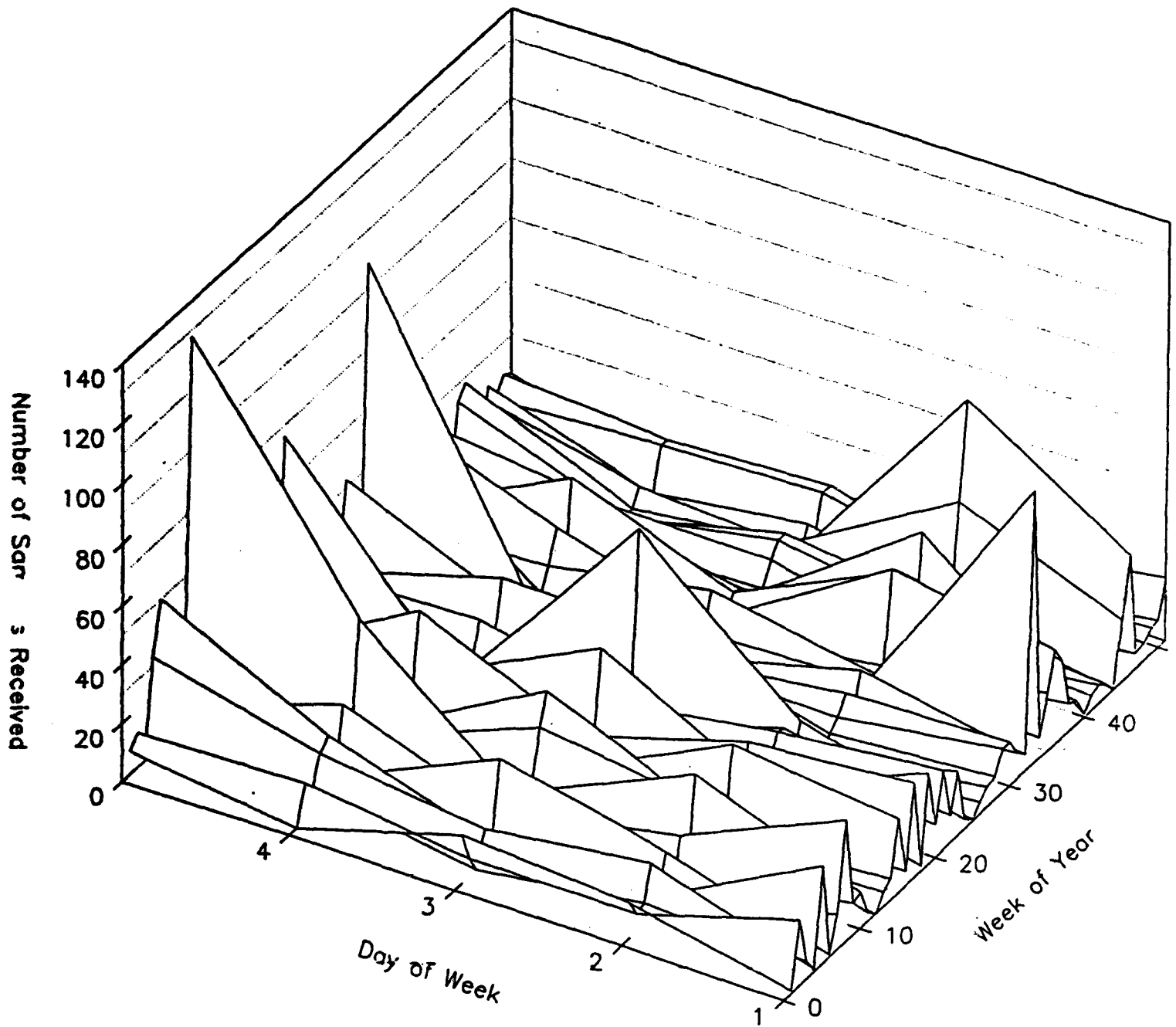
Need/Purpose: To identify all factors which contribute to
overall sample turnaround times.

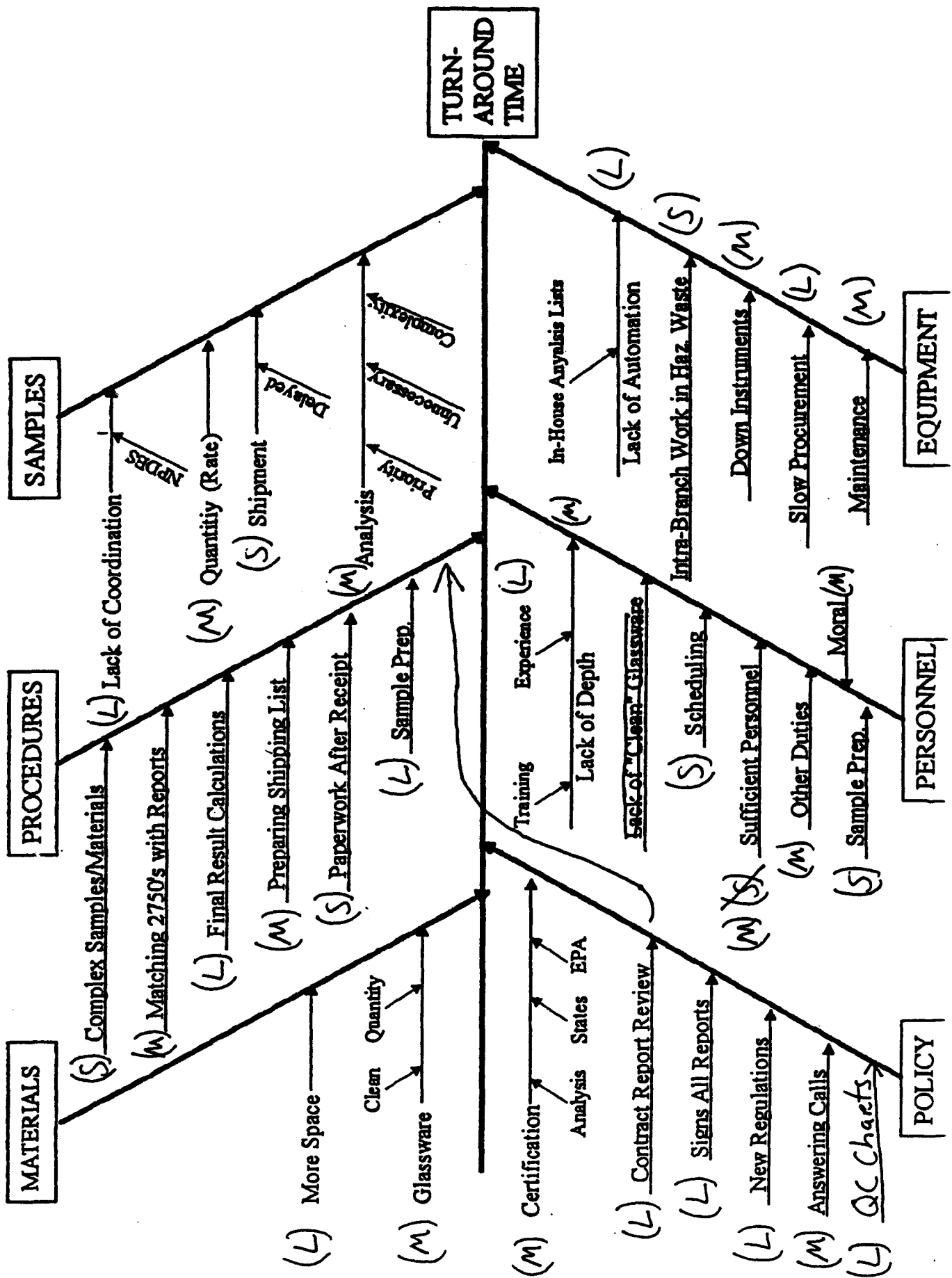
How: Developed through group brainstorming and employing
the function flowchart.

Make Note Of: (L) Large effect on turnaround times
(M) Medium effect on turnaround times
(S) Small effect on turnaround times

Visit Commercial Laboratory-DataChem Inc., and Governmental
Occupational Chemistry Laboratory-OSHA in Salt Lake City

SAMPLES RECEIVED FOR FUNCTION 11 BY DAY





TOPIC: Trip Findings on Salt Lake City Visit of Data Chem, OSHA

I. TURNAROUND TIMES:

- a. TAT God/Expediter on special problems
- b. Drop Unnecessary Certifications
- c. Cut-back on Quality Assurance
- d. Add Penalties to Contractor Non-Performance
- e. Establish Target/Estimated Completion Dates
- f. Multiple Level of Approval?
- g. Screening Tests in Field?
- h. Sample Prep Drives Work, Drives Operation
20/Organic 17/Inorganic-Personel in Prep
- i. "Hit List"
- j. Break-up Sampling Number System Differently to Slant TATs?
- k. Individual Function Matrices
- m. Coversheet Signature Idea

II. LABORATORY AUTOMATION:

- a. Data Chem on Same Wavelength in Laboratory Automation Approach
- b. Bar Coded Refrigerators to Identify Where Samples are
- c. Different Lab Automation Approach Headed by ADPE Person/
Coordinates with Chemist
- d. AutoRefill for Argon/Nitrogen
- e. Electronic Data Transfer of Results to their Customers!
- f. AutoFax
- g. Centralized Data Collection/LAS into LABUX
- h. Investigate Lease Equipment
- i. Data Chem has Unified Data System-Drives more Training

III. PERSONNEL:

- a. Surge Capabilities-Train People in Other Areas, Pull People to Where Needed
- b. OSHA-People Going TDY, Need it Stress relief/Reward
- c. Data Chem had In-House Electronic Repair Service Person
- d. Flexible training Schedule
- e. Separate Long term Waste Storage, Separate Group to Dispose of Waste
- f. "Bullpen" Idea
- g. 5 x More Space, 3-4 x Personnel to do Same Workload
- h. Career Ladder Based on Evaluation/ED/Exp. Salary According/Keeps People
- i. Samples Receiving for Start-up, Education Driven Program, 2 year after program - paid well, zero turn over of personnel
- j. Flex Time at OSHA. Can work 10-12 hrs/day
- k. Double Shift in Practice
- l. Seven Days a Week Operation
- m. Inorganic/Organic Sample Prep Areas
- n. Non-Compliance/Problem Samples Handled By loading Dock People

IV. COORDINATION:

- a. OSHA Had On-Call Contracts!
- b. Chemists/Technicians Went to Get their own Samples
- c. Don't Perform Non-Profit Type Work
- d. Control Charts Displayed
- e. POC Contact
- f. Have Productive Weekly Meetings

V. PIT

- a. Very Interested in our PIT Approach-Forecasting Workload**
- b. All Refrigerators Locked**
- c. Data Chem-Creative Space utilization**
- d. Individual Vents for Instruments**
- e. Hot HNO Wash of Glassware/Stored Glassware with D-H O**
- f. Established a Voucher System**
- g. List of Responsibility of Analysts - Posted which Motivates People**

Attachment 3.3B - Determination of Most Significant Improvement Opportunities

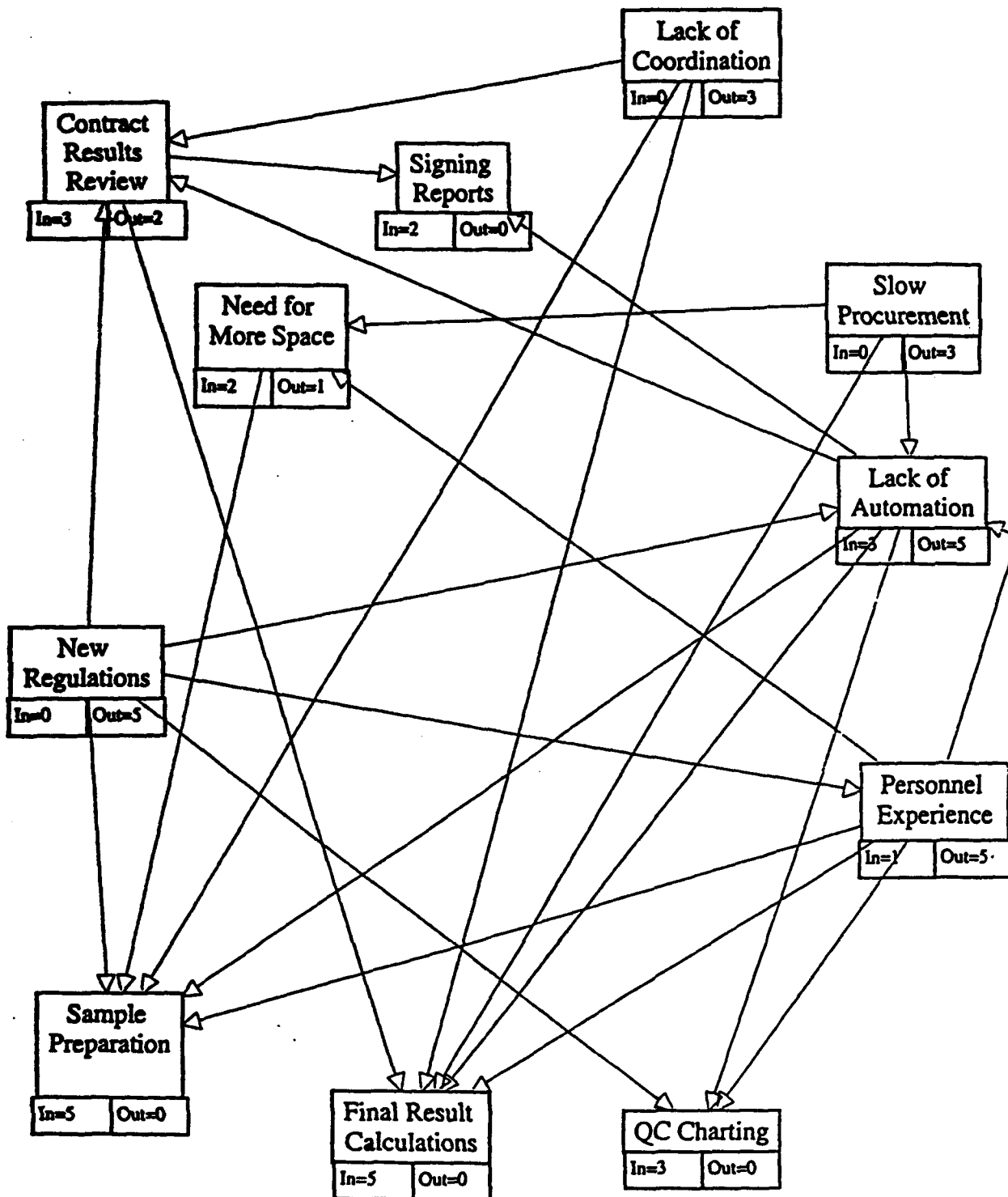
When Prepared: Interrelationship Digraph - Feb 93

Need/Purpose: After identifying areas for improvement, the digraph was used to zero in on areas which would have the biggest impact on the overall process.

How: The digraph was developed via group brainstorming.

Make Note Of: Lack of automation, personnel experience and lack of coordination impact the analysis areas over which the PIT has some control.

What are the major issues that might increase cycle time in the Metals function?



Attachment 3.5 - Final Statement of the Process to Be Improved

When Prepared: Recommendation of PIT Team - Feb 93

Need/Purpose: To keep staff informed on PIT group progress and findings.

How: Letter issued by Division Chief to Branch Chiefs. The Branch Chiefs held meetings to inform the analysts of the PIT approaches.



DEPARTMENT OF THE AIR FORCE
ARMSTRONG LABORATORY (AFMC)
BROOKS AIR FORCE BASE, TEXAS

FROM: PIT Team

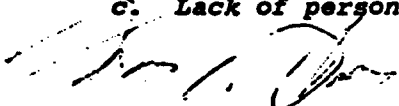
SUBJ: Recommendation of PIT Team

2 FEB 1993

TO: AL/OEA
2402 E Drive
Brooks AFB TX 78235-5114

The PIT Group will zero in on the following areas in order to improve our quality character of decreasing analysis turnaround time:

- a. Lack of customer coordination
- b. Lack of needed automation
- c. Lack of personnel experience


THOMAS C. THOMAS, GM-15
Chief, Analytical Services Division

Attachment 3.6A - Tools Used in Root Cause Analysis

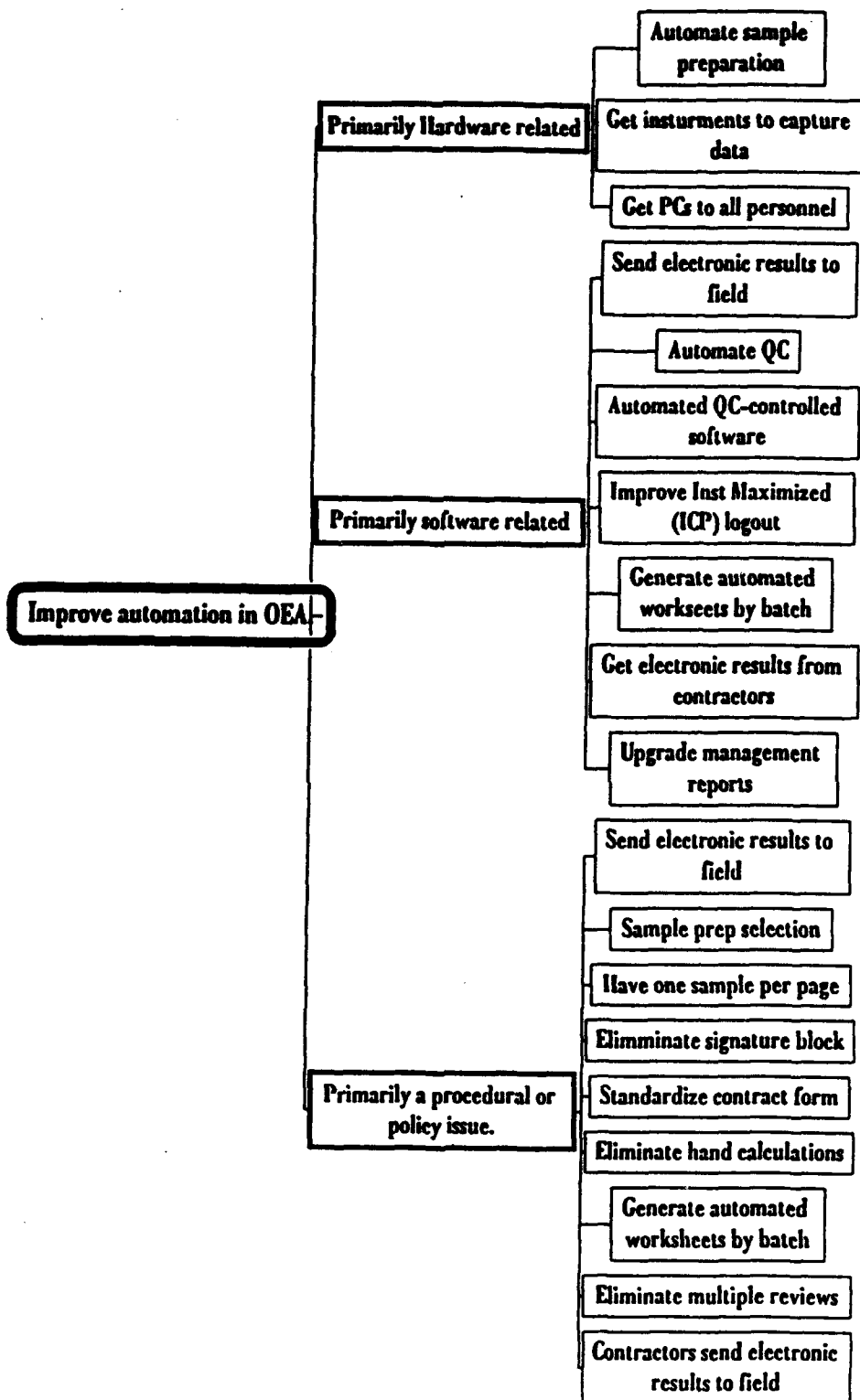
When Prepared: March-April 1993

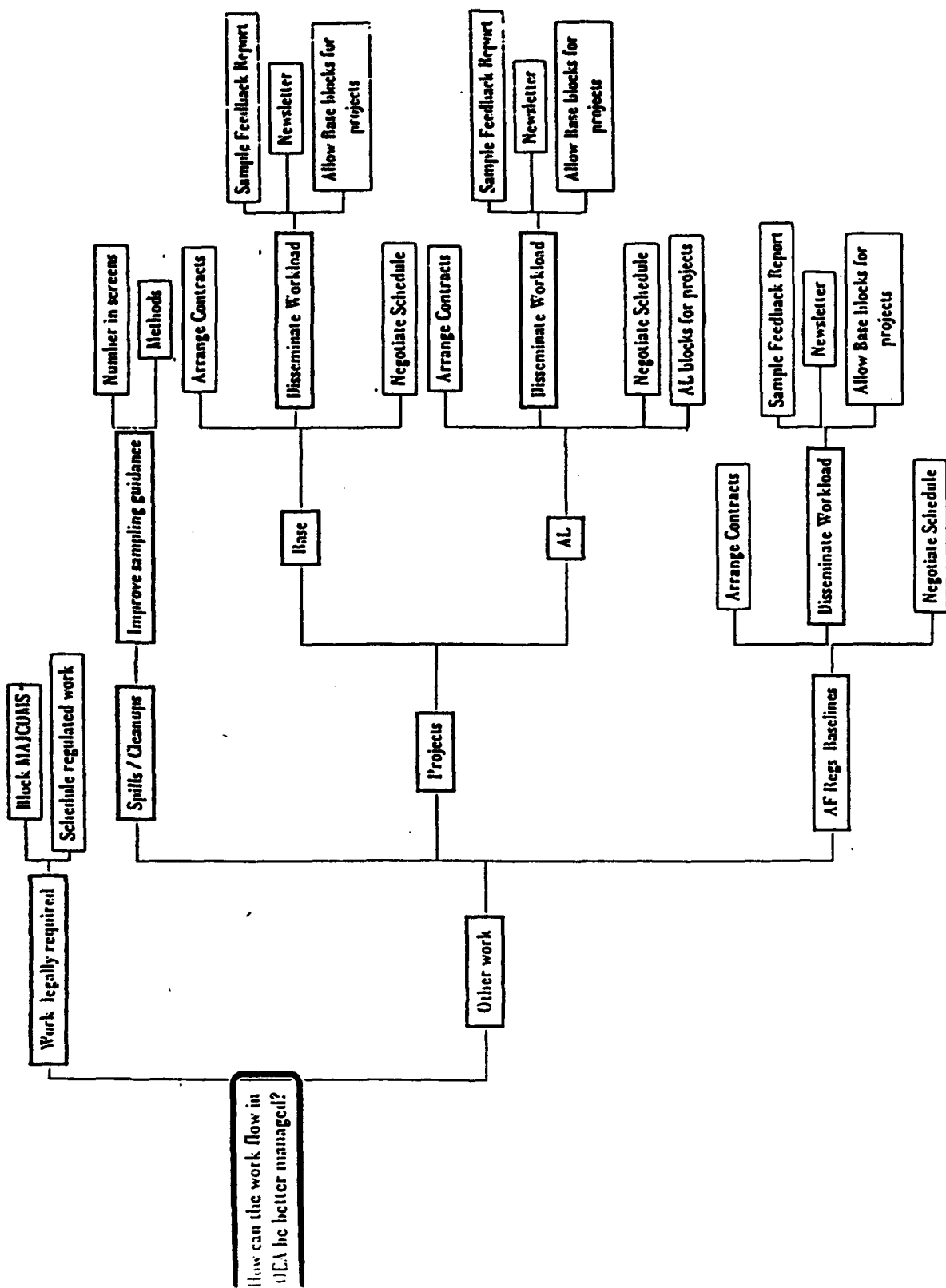
Need/Purpose: Root causes of major problems had to be identified and verified. If root causes can be fixed, major problems will be solved and the process improved.

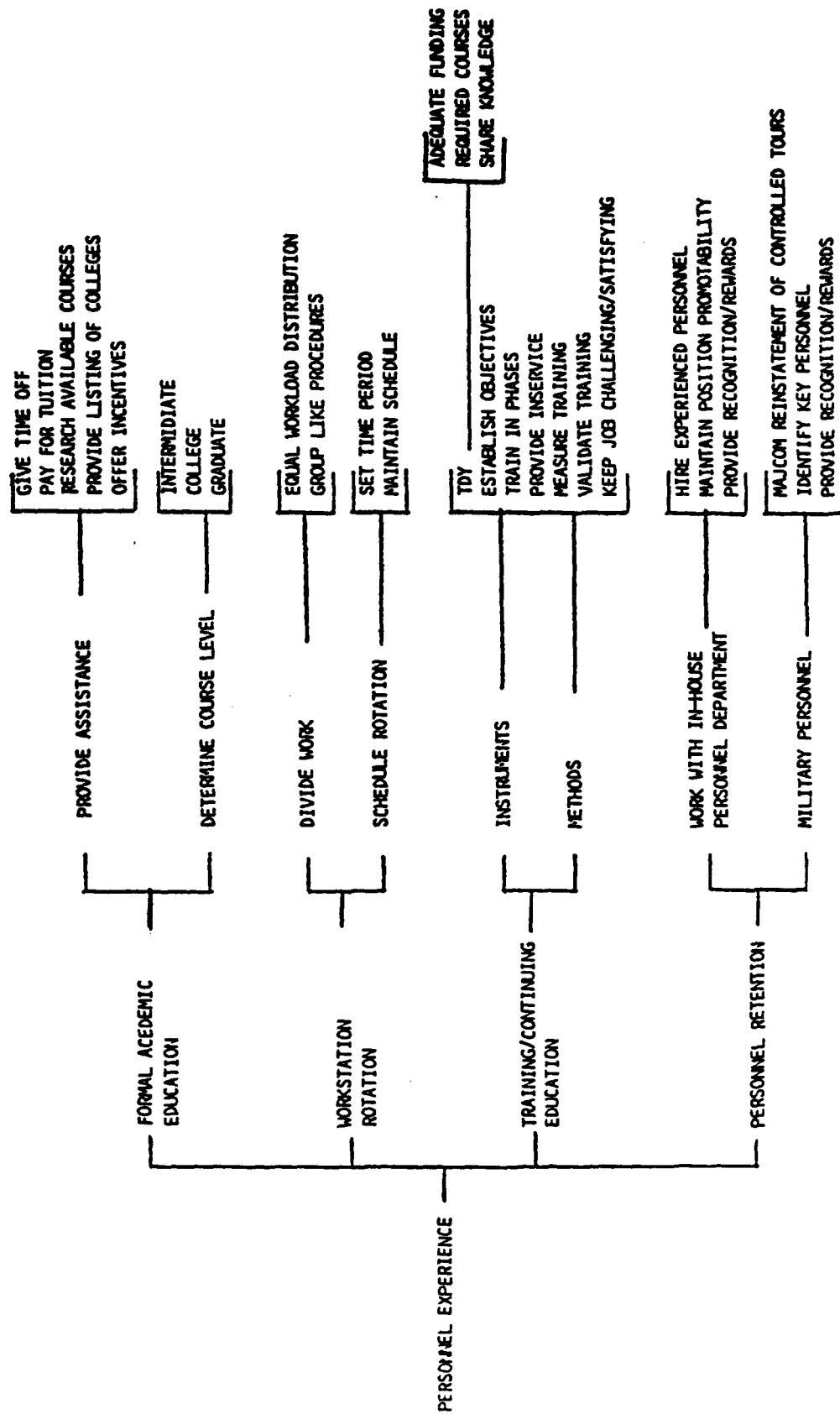
How:

Tree Diagrams - The PIT group broke into sub-groups and came up with ideas for tree diagrams. PIT group then met and brainstormed final diagrams.

Make Note Of: Tree Diagrams - 3 Charts







Attachment 4.3 - Team Action Plans

When Prepared: Direct Data Transfer for Metals - Apr 93
Electronic Mailing of Results - Mar 93
Implementation of Coversheet - Mar 93

Need/Purpose: To establish a schedule for implementing process improvements selected by the team.

How: Interfaced with personnel who would be involved in the implementation to determine time required for each facet of the proposed improvements.

Rating of Root Causes - Matrix diagraming and rating was accomplished by the PIT Group to identify key root causes. The group to voted comparing root causes versus criteria, with majority vote ruling

DIRECT DATA TRANSFER FOR METALS

20 April 1993

PC PORTION

13 Apr - Down loading of data from instrument started.

20 Apr - Data Transfer from instrument to PC and edit capability complete. Review time line.

21 Apr - 1Lt Wheeler tests upload program for user friendliness

22 Apr - Start programming QC features

27 Apr - QC programs complete

28 Apr - Test QC portion

29 Apr - Program upload portion

4 May - Upload portion complete

5 May - Start testing complete system

11 May - System in operation

12 May - Fine tune system

June - Start Manual Entry

Mid-June - Evaluate Manual Entry

July - Implement in other locations in lab

LABUX

13 Apr - Design started for upload program.

20 Apr - 23 Apr - Resolve upload parameters.

IMPLEMENTATION OF ELECTRONIC MAILING OF RESULTS

- 29 March 93 - Begin initial testing of electronic mailing of results.
- Four test bases will be: Kelly, Reese, Vandenberg, Andrews.
 - Begin with metal section only.
 - Working group: Long, Oakes, Swartz
- 19 April 93 - Survey test bases to gauge response to E-Mailing.
- 3 May 93 - End of initial period in metals function. Group to review feedback.
- 6 May 93 - Begin testing in multi-functional areas: pesticides, TCLP, metals, volatiles, BC/MS and hazardous waste.
- Add two bases, Hahn and Robins.
 - Add a "heads up" page to analytical report to inform chemist results can be electronically mailed.
- 28 June 93 - Survey test bases and chemist to gauge how E-Mail of results are going.
- Entire team to phone bases
- 26 July 93 - End of test period.
- Start establishing E-Mail accounts for all bases.
- Implementers: Swartz, Oakes
- Spring 94 - Full implementation of E-Mail results to all customers with E-Mail capability.

IMPLEMENTATION OF COVER SHEET

- 29 March 93 - Start report cover sheet test in metals sections.
Working group: Long, Jehl, Oakes
- 13 April 93 - End of initial test period.
Report by Long
- 13 April 93 - Begin testing of report cover letters lab wide.
Implementation group: Jehl, Wiley, Garland, Long, Oakes,
function and branch chiefs.
- 13 May 93 - Test period concluded.
Report and recommendations by same group.

How can the work flow in
OEPA be better managed?

(Rating Factor: 1.00 Worst to 5.00 Best) Fraction Indicates Weighting Criteria.

	Low Manpower to Implement	Big reduction of turnaround time	High Chance of Success	High Spin-off Potential	Increases Capacity	Short time to Implement	Total
Block MAJCNIS for regulated work	(5.00)0.20	(5.00)1.80	(4.00)0.96	(5.00)0.15	(1.00)0.24	(4.00)0.04	3.39
Schedule regulated work	(3.00)0.12	(5.00)1.80	(2.00)0.48	(5.00)0.15	(1.00)0.24	(4.00)0.04	2.83
Improve sampling guidance for spills/cleanups	(4.00)0.16	(4.00)1.44	(5.00)1.20	(5.00)0.15	(5.00)1.20	(5.00)0.05	4.28
Disseminate workload for all work	(3.00)0.12	(3.00)1.08	(5.00)1.20	(5.00)0.15	(1.00)0.24	(4.00)0.04	2.83
Change Form Layout	(3.00)0.12	(5.00)1.80	(4.00)0.96	(5.00)0.15	(5.00)1.20	(2.00)0.02	4.25
Newsletter for base project work	(3.00)0.12	(3.00)1.08	(2.00)0.48	(5.00)0.15	(1.00)0.24	(3.00)0.03	2.18
Allow Base blocks for base project work	(4.00)0.16	(4.00)1.44	(4.00)0.96	(5.00)0.15	(1.00)0.24	(3.00)0.03	2.98
Negotiate Schedule for base project work	(4.00)0.16	(4.00)1.44	(4.00)0.96	(5.00)0.15	(1.00)0.24	(3.00)0.03	2.98
Negotiate schedule for AL project work	(5.00)0.20	(2.00)0.72	(5.00)1.20	(3.00)0.09	(1.00)0.24	(5.00)0.05	2.58
AL blocks for projects for AL project work	(5.00)0.20	(4.00)1.44	(5.00)1.20	(3.00)0.09	(1.00)0.24	(5.00)0.05	3.22
Disseminate workload for AF Regs baselines	(4.00)0.16	(3.00)1.08	(4.00)0.96	(5.00)0.15	(1.00)0.24	(3.00)0.03	2.82
Allow Base blocks for projects for AF Regs baselines	(4.00)0.16	(3.00)1.08	(4.00)0.96	(5.00)0.15	(1.00)0.24	(3.00)0.03	2.82
Negotiate schedule for AF Regs baselines	(3.00)0.12	(3.00)1.08	(4.00)0.96	(5.00)0.15	(1.00)0.24	(3.00)0.03	2.58
Allow Base blocks for projects for AL project	(5.00)0.20	(4.00)1.44	(4.00)0.96	(3.00)0.09	(1.00)0.24	(5.00)0.05	2.98

SOLUTION RATING FOR LAB AUTOMATION IMPROVEMENTS IN METALS

SIGNATURE COVER SHEET - 4.39

IMPROVE ICP DATA/RESULT LOGOUT PROCEDURE - 4.25

ELIMINATE HAND CALCULATIONS - 4.22

SEND ELECTRONIC SAMPLE RESULTS TO FIELD - 4.21

HAVE CONTRACTORS MAIL SAMPLE RESULTS TO FIELD - 4.15

TECHNICIANS/CHEMISTS ENTER DATA - 3.88

GENERATE AUTOMATED SAMPLE "HIT LIST" - 3.79

STANDARDIZE CONTRACT LAB RESULT FORMS - 3.46

HAVE MULTIPLE SAMPLE RESULTS PER PAGE - 3.42

GET ELECTRONIC SAMPLE RESULTS FROM CONTRACTORS - 3.28

GENERATE AUTOMATED WORKSHEETS BY BATCH - 2.91

START A CUSTOMER SERVICE STATUS LINE - 1.92

How can the work flow in
(IEA) be better managed?

Change Form Layout	4.25
Improve sampling guidance for spills/cleanups	4.20

AL blocks for projects for AL project work	3.22
Block MAJCOMS for regulated work	3.39

Allow Base blocks for projects for base project work	2.98
Negotiate Schedule for base project work	2.98
Allow Base blocks for projects for AL project	2.98

Schedule regulated work	2.83
Disseminate workload for all work	2.83

Disseminate workload for AF Regs baselines	2.62
Allow Base blocks for projects for AF Regs baselines	2.62

Negotiate schedule for AF REgs baselines	2.58
Negotiate schedule for AL project work	2.50

Newsletter for base project work	2.10
----------------------------------	------

Rating Returns for Improving Personnel Experience

Provide for Workstations Rotations - 3.89

Establish & Validate Training Objectives - 3.18

Work with Civ Personnel Departments to Improve Retention - 3.10

Identify Key Military Personnel - 2.99

Request MAJCOM to Reinstate Control Tours - 2.86

Allow Flex Time for Education - 2.78

Increase Opportunities for In House/TDY Training - 2.73

Provide Recognition/Rewards for Personnel - 2.44

Offer Incentives/Rewards for Education - 2.30

Advertise Current Programs for Tutoring/Other Ed. - 2.01

Help Determine Appropriate Course Levels - 1.76

Attachment 6.3 - Metrics Used on an On-Going Basis To Ensure Continuous Process Improvement

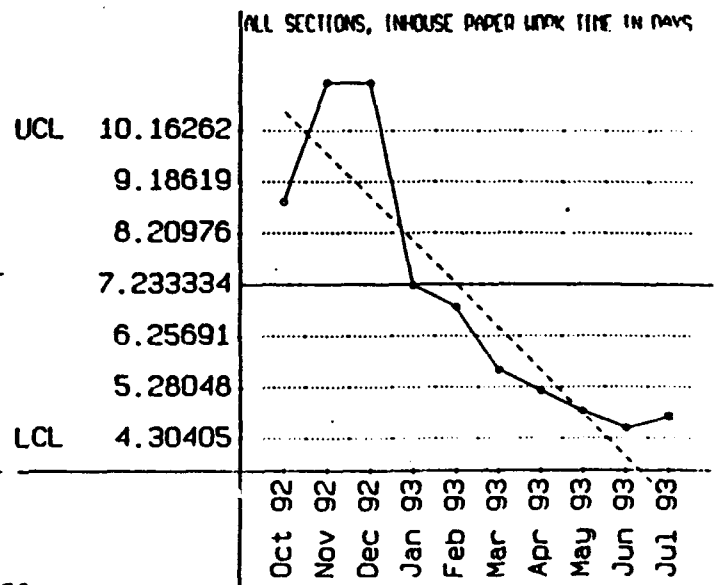
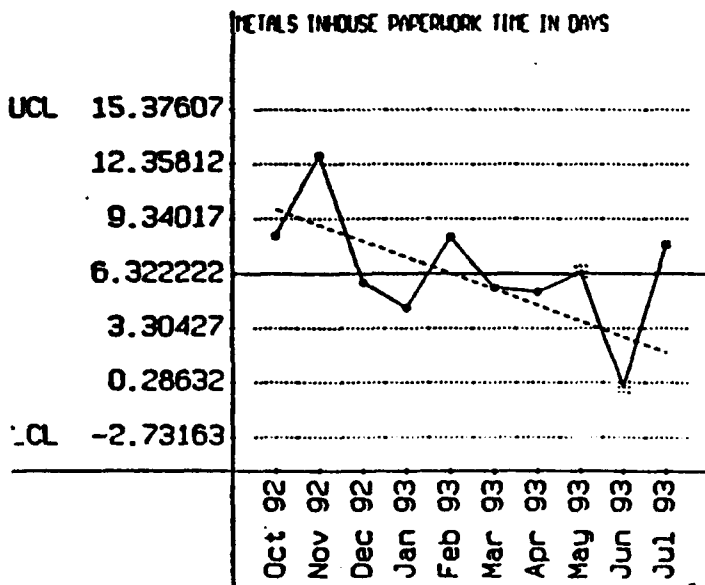
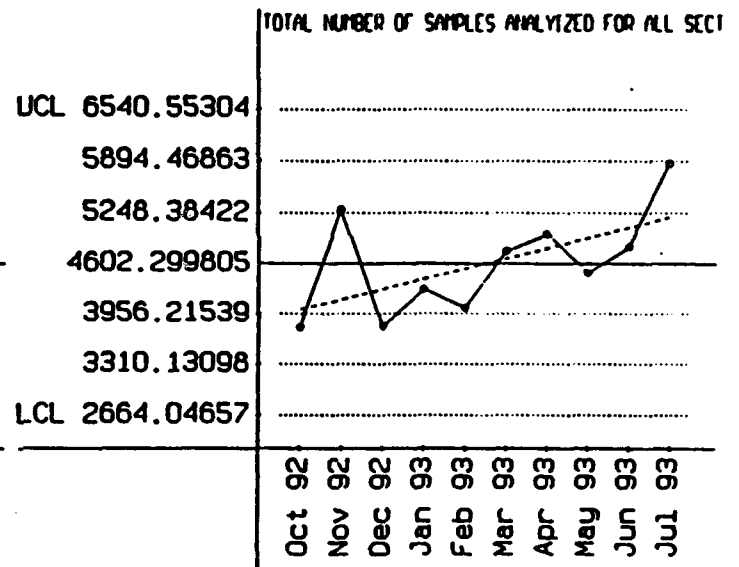
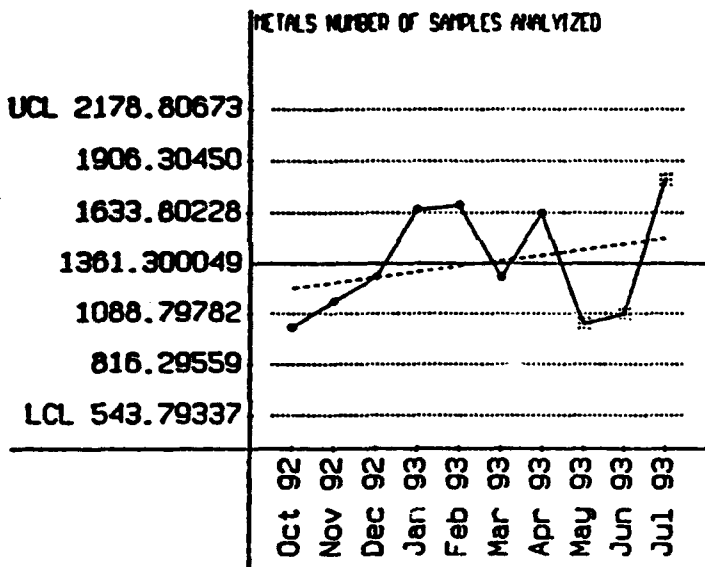
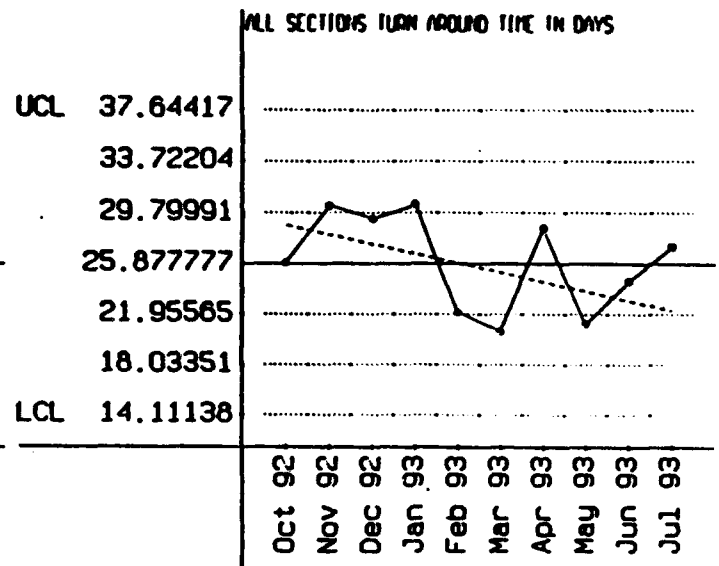
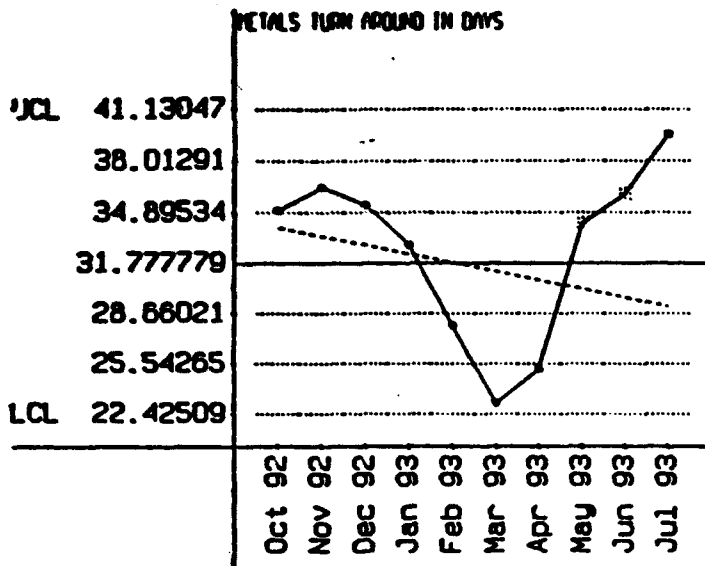
When Prepared: April - August 1993

Need/Purpose: Process control and management metrics utilized to monitor results and insure continuous process improvement.

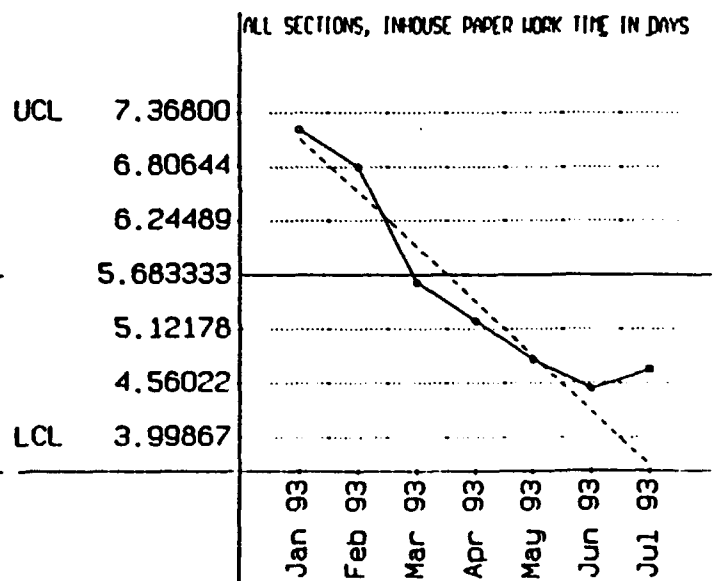
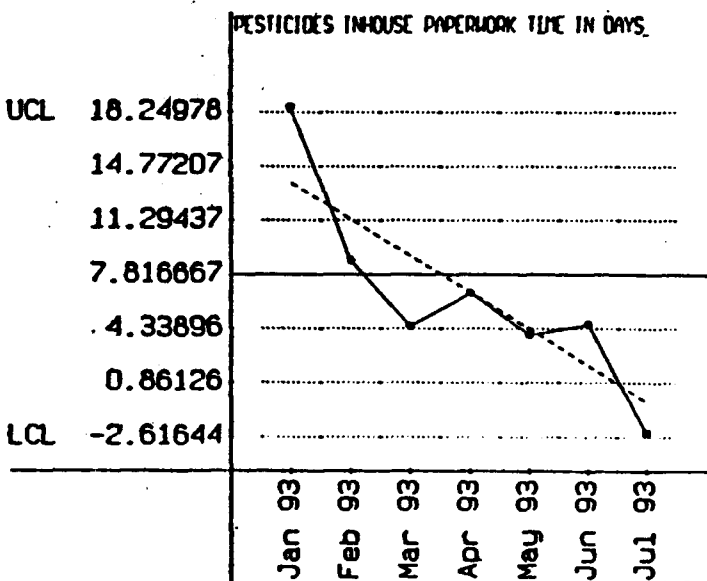
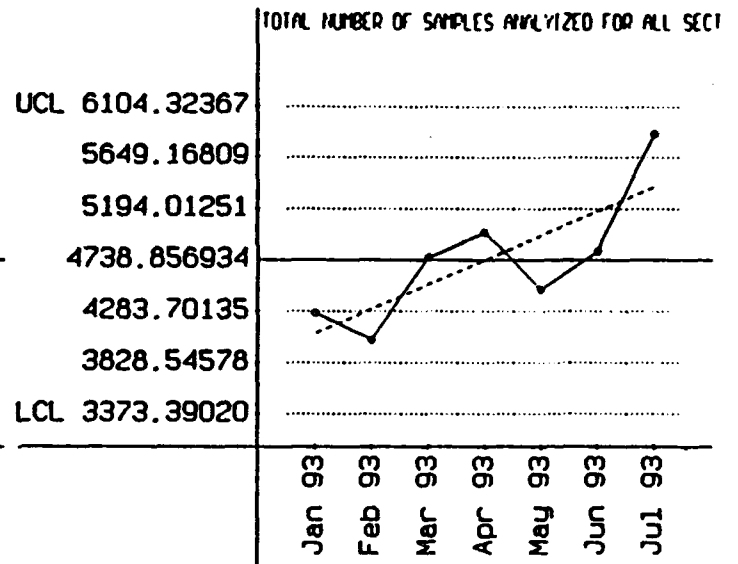
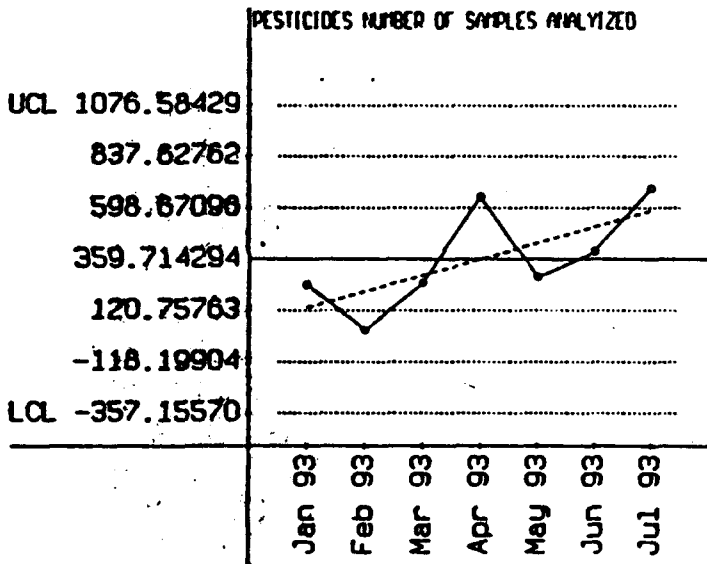
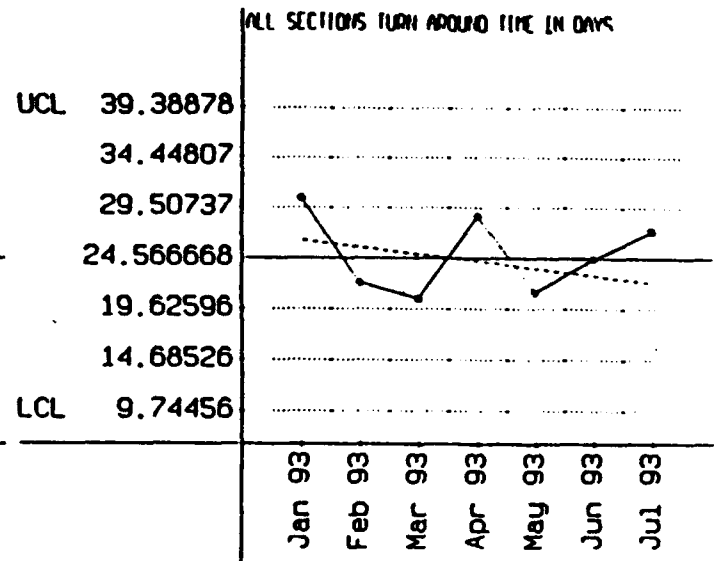
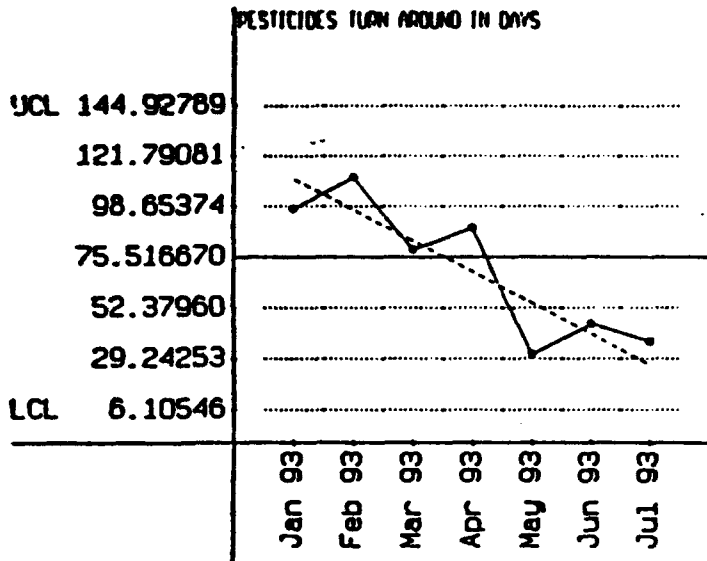
How: Performance charts to monitor analysis turnaround times, customer service, and capacity.

Sample suspense and sample suspense management lists are to ensure better turnaround times were being achieved.

INHOUSE METALS SECTION vs ALL SECTIONS PERFORMANCE 1992-1993



INHOUSE PESTICIDE SECTION vs ALL SECTIONS PERFORMANCE 1992 1993



**ANALYTICAL SERVICES DIVISION
SAMPLE SUSPENSE LIST**

PAGE 1

WORKCENTER: 10900 GC/MS ANALYSES

DATE/TIME: 12-Aug-93 16:20:22

OEA SAMPLE #	PRIORITY	RECEIVED DATE	SUSPENSE DATE	CURRENT STATUS	CONTRACTOR	CALL NUMBER
93036696	9	930720	930810	Tests Requested		
93035798	9	930715	930819	Tests Requested	RABA	361493
93035799	9	930715	930819	Tests Requested	RABA	361493
93035871	9	930715	930819	Valid Complete	RABA	363093
93035874	9	930715	930819	Valid Complete	RABA	363093
93036213	9	930715	930819	Valid Complete	CLAY	361693
93036214	9	930715	930819	Valid Complete	CLAY	361693
93038353	9	930730	930820	Tests Requested		
93036697	9	930720	930824	Valid Complete	RABA	362593
93036701	9	930720	930824	Valid Complete	RABA	362593
93036723	9	930720	930824	Valid Complete	RABA	362393
93036724	9	930720	930824	Valid Complete	RABA	362393
93036866	9	930721	930825	Valid Complete	RABA	363193
93036867	9	930721	930825	Valid Complete	RABA	363193
93036868	9	930721	930825	Valid Complete	RABA	363193
93036869	9	930721	930825	Valid Complete	RABA	363193
93037003	9	930722	930826	Valid Complete	RABA	363293
93037004	9	930722	930826	Valid Complete	RABA	363293
93037017	9	930722	930826	Valid Complete	RABA	363293
93037018	9	930722	930826	Valid Complete	RABA	363293

PCN: OEA0002

ANALYTICAL SERVICES DIVISION

SAMPLE SUSPENSE MANAGEMENT LIST

SAMPLES WHOSE MAIL DATE EXCEEDED THE SUSPENSE DATE

DATE/TIME: 30-Aug-93 08:35:44

FUNCTION: 02 Pesticide Function

FUNCTION CHIEF: Mr. Dennis Mark

OEA SAMPLE #	RECEIVED DATE	SUSPENSE DATE	MAIL DATE	CONTRACT LAB	CONTRACT CALL NUMBER
-----------------	------------------	------------------	--------------	-----------------	-------------------------

93033801	930706	930727	930805		
93033802	930706	930727	930805		
93033803	930706	930727	930805		
93033804	930706	930727	930805		
93033805	930706	930727	930805		
93033806	930706	930727	930805		
93033807	930706	930727	930805		
93034728	930709	930813	930818	RABA	360093
93034729	930709	930813	930818	RABA	360093
93034730	930709	930813	930818	RABA	360093
93034731	930709	930813	930818	RABA	360093
93034732	930709	930813	930818	RABA	360093
93034733	930709	930813	930818	RABA	360093
93034734	930709	930730	930801		
93036039	930716	930820	930826	RABA	362093
93036040	930716	930820	930826	RABA	362093
93036041	930716	930820	930826	RABA	362093
93036042	930716	930820	930826	RABA	362093
93036043	930716	930820	930826	RABA	362093
93036044	930716	930820	930826	RABA	362093
93036045	930716	930820	930826	RABA	362093
93036046	930716	930820	930826	RABA	362093
93036717	930720	930824	930825	RABA	362693
93036718	930720	930824	930825	RABA	362693
93036719	930720	930824	930825	RABA	362693
93036720	930720	930824	930825	RABA	362693
93036721	930720	930824	930825	RABA	362693
93036722	930720	930824	930825	RABA	362693
93038215	930729	930819	930830		
93038216	930729	930819	930830		
93038543	930802	930823	930826		

TOTAL SAMPLES WITH EXCEEDED SUSPENSES: 31

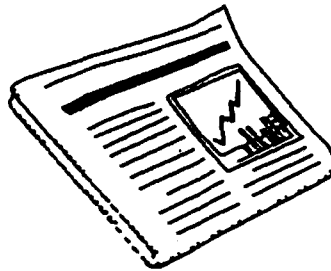
Attachment 7.2C - Benefits of the Team and Lesson Learned Communicated to Other Teams, Management, and the Rest of the Organization

When Prepared: Storyboard - Feb 93
AL Newsletter - Spring 93
OE Newsletter Article - Fall 92
Customer Satisfaction Survey -
Apr-Aug 93
Customer Feedback on Electronic Mailing -
Apr 93
Cover Letter Explanation - Apr-May 93

Need/Purpose: To communicate existence of AL/OEA PIT, it's progress and improvements, and to help later TQ teams in their efforts.

How: Storyboard - Combine Team Effort
AL/Newsletter - Prepared by PIT facilitator
OE Newsletter - Article written by team effort
Customer Satisfaction Survey - Developed by Team
Cover Letter Explanation - Developed by Team effort

EXTRA, EXTRA



PIT STORYBOARD SETUP IN ARMSTRONG LABORATORY HEADQUARTERS LOBBY

QUALITY AF

Armstrong Laboratory

Commentary

In this first QUALITY AIR FORCE newsletter I would like to share with you some of the important strides we have made within the Laboratory segment of the HSC community to promote quality. Unfortunately, or more correctly—fortunately, much of what has taken place is not yet visible at the "working level" within the Laboratory.

As I stated to you in my Jan 92 letter distributed inside the TQL DICTIONARY, *"My initial efforts will be focused on getting senior management to understand the important role we must play in the TQL process, and the behavioral changes we must make as a leadership team if TQL is to survive."* Much of the Total Quality emphasis is still focused on the top of the organization where it is needed.

Our Total Quality efforts could be more visible at the "working" level where research, consultation, and teaching take place if we could speed up the rate of "cultural" change in our organization. Cultural change takes time, however, and if you push too hard things can break.

We certainly have enough change taking place today to keep all of us busy, but not all of it is cultural-type change.

Some valuable and interesting things have been happening within the last 12 months. I'd like to review just a few of them with you.

- monthly readings on "quality" are distributed to the top 250 leaders within HSC;
- a 30 page TQL DICTIONARY was distributed to all AL personnel;
- a 32 page TEAM HANDBOOK was created for use by AL Teams;
- an AL Quality Council has been formed and although it has not been meeting regularly to date, it will start this Fall;
- a full-time TQL Advisor position was created, reporting to the Laboratory Director and supporting the Quality Council's activities;
- Two PIT Teams have been Chartered by the Quality Council, have received PIT Team training and are meeting regularly;
- A large conference room in Building 125 has been identified and reserved for PIT Team use;
- Over \$15,000 worth of books, videos and audiovisual equipment was purchased for placement in the dedicated PIT Team room;
- 6 AL Facilitators have been trained, and 4 of them are spending 20% of their time in AL-specific TQL activities;
- a 4-hour TQL "awareness seminar" has been developed for Armstrong Laboratory personnel and will be available this Fall;
- The Quality Council has visited a worldclass R&D-based company, the Dow Chemical Company, to review their Total Quality efforts;
- The Quality Council has attended two, day-long executive seminars on Total Quality, and more are scheduled in the future;
- \$100,000 was budgeted to support AL Total Quality efforts in FY92 and FY93;



There are many other things I could mention as well. But let me close on this note. As the Director of this Laboratory I have not been able to [see "Commentary" page 4"]

ANALYTICAL SERVICES (OEA) PIT TEAM CHARTERED BY DR WELCH

Teams have existed on Brooks AFB for as long as the base has existed. But in August of 1992 two very special Teams were formed, one in OEA and the other in AOT. More about the AOT Team in the next issue of QUALITY AF. What makes these Teams so special? What is special is the way in which they are being selected, trained and nurtured.

First, a short history lesson. In Jan 1992 General Anderson sent a letter to the Laboratory explaining his vision for HSC to be "a leader in environmental restoration, protection and compliance." Shortly thereafter, HSC Vice Commander Klein sent Dr Welch a letter applauding the proud history of OE, and encouraging us to find ways to shorten OEA "response times" in order to capture the 62% of Air Force environmental samples currently being analyzed elsewhere. In May of 1992 Dr Welch directed the Laboratory Total Quality Advisor (AL/TQ) to establish a PIT Team in both OEA and AOT.

During the months of June and July, three facilitators (Dr Cupello, Dr Murphy and Cpt

Engquist) started meeting regularly with Mr Tom Thomas, the OEA Division Chief, to more clearly define what this Team should accomplish.

A preliminary look at the way environmental samples are processed revealed that the

training in group dynamics and quality tools. This intensive course was offered by Change Navigators out of Colorado.

The Team has been meeting for 90 minutes every Tuesday morning since then. They are following a 14-step method for

process improvement. To date they have developed a mission statement, analyzed over 40 control charts worth of "capacity" and "turn-around time" data, and have just recently begun flow charting the work processes for met-

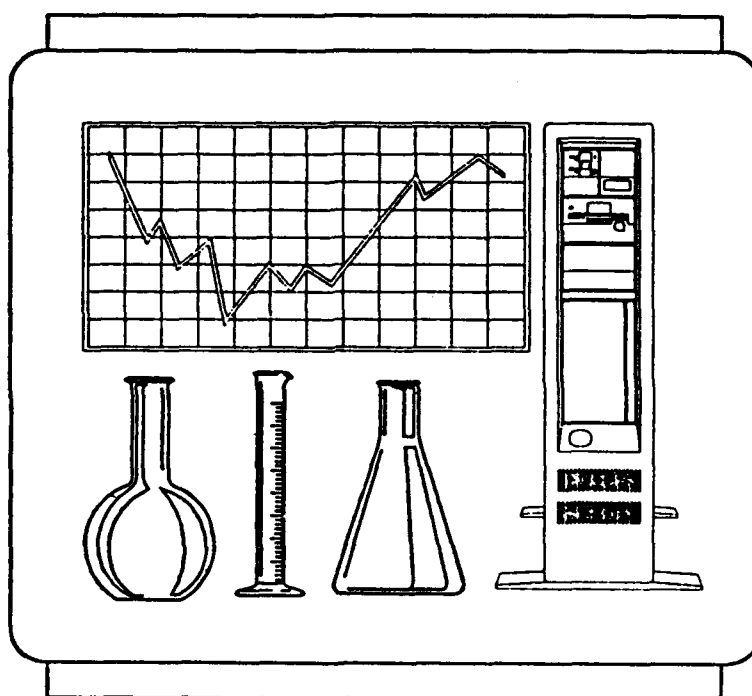
als, pesticides, haz/tox and customer service.

Dr Jim Cupello, the Team Facilitator, has commented, "I have never met a more positive, enthusiastic, hard working, aggressive Team as this one. When they are finished with this assignment, everyone will be able to tell the difference in OEA. Everyone! But management must have the courage to make the changes the Team recommends."

"analysis" step was the most time consuming.

In early August Mr Thomas identified nine individuals to serve on the OEA PIT Team, including an internal customer (OEB) and function chiefs heading three of the 11 analytical functions: metals, pesticides and hazardous/toxic materials.

During the week of 24 August the AOT and OEA PIT Teams received four days of





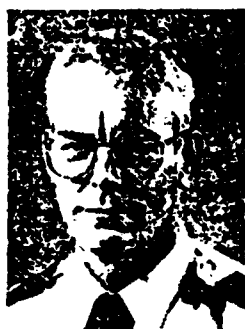
2Lt Chris Cortez



Guadalupe Cruz



Cpt Sheree Engquist
Facilitator



Maj John Garland
Internal Customer



Leo Jehl



Cornell Long



Dr Michael Murphy
Facilitator



Maj Lloyd Swartz



Tom Thomas
Team Leader



TSgt Dan Thompson



Cpt Tim Wiley

Commentary

spend as much time as I would like on Total Quality efforts within the Laboratory. The DOD environment is changing so rapidly that a great deal of my time is spent on survival issues; I must deal with that which is urgent, not necessarily what is important. Sometimes it is impossible to tell which is which.

Burt Nanus, an acknowledged expert on leadership, summed it up this way:

"... why is leadership inadequate? The answer is that the prevailing wisdom about leadership has become dangerously unbalanced. Leadership is seen as primarily ... concerned with the relationship between the leader and the follower or organization ... The conditions of the new age demand at least as much attention to the ever-changing external environment as to the internal or organizational environment."

I can promise you two things relative to the future of TQL within the Armstrong Laboratory. I will make every effort to get the Quality Council meeting on a regular basis to discuss "quality," and I will also begin the process of pushing the quality effort down into the organization by emphasizing the creation of Directorate-level Quality Councils and PIT Teams at the earliest opportunity. [Dr Billy E. Welch].



Quality Books In Review

RIGHT EVERY TIME: USING THE DEMING APPROACH by Frank Price. A Review by Lt Col Bob Cartledge, AL/OEDL

Dr W. Deming's strength is his weakness. He articulates a profound philosophical landscape of quality management but provides little insight as to how to till the garden and when to plant the crops. Frank Price, in his book, fills the role of the county agricultural agent, translating what the professor said into a language we can understand.

Mr Price begins his book with an extraordinary introductory chapter about organizational cultures. If nothing else, get the book just to read the first chapter. Cultures, per Mr Price, are like mountains, each with different perspectives on the organizations. Cultures, which range from "please the boss" to "please yourself" are organizational glues. Mr Price skillfully argues that the glue ought to be Quality.

RIGHT EVERY TIME is organized around Deming's fourteen points. Unlike many other authors, Mr Price groups similar points into a single chapter. This approach helps to put the Fourteen Points into unifying themes and to simplify, somewhat, the Quality implementation process. The book employs a wide cross-section of examples to enlighten the reader about Quality. These examples range from a discussion of training and education in the early days of medicine to the purchase of nails to shoe horses in the U.S. Cavalry. In other words, don't expect an endless litany of examples of 1980's business failures and turnarounds, illustrating how TQM will save the American economy. Mr Price cultivates his Quality garden with a unique blend of insight, humor, history, and wisdom.

Mr Price believes in Deming so much, that the praise sometimes becomes a little too thick. But don't let that dissuade you from digging into Mr Price's words.

I don't know how many non-believers will see the Quality light after reading this book. But if you are curious about Deming, **RIGHT EVERY TIME** should be in your TQM library. In fact, the book does such a good job expressing Dr Deming's philosophy that I recommend reading it before Dr Deming's **OUT OF THE CRISIS**.

[Two copies of this book are available in the AL/TQ office; contact Dr Cupello (4-2091) for 1 week checkout. The book was originally published by Marcel Dekker, Inc. for \$65 and may still be available from that source]



ARMSTRONG LABORATORY

OCCUPATIONAL AND ENVIRONMENTAL HEALTH DIRECTORATE NEWSLETTER



Director: John C. Mitchell, SES

Editor: Capt Sharon L. Spradling

AL/OE Newsletter - November 92
Volume 16, No. 3

Analytical Services Division Process Improvement Team: The Analytical Services Division has initiated a Process Improvement Team (PIT) with an objective of improving analytical response time, improving the capacity of the laboratory, and communicating our services to our customers. The team is led by Mr Thomas, Chief of the Analytical Services Division and includes other representatives from Analytical Services, Bioenvironmental Engineering Division, and supporting personnel for providing statistical, data, and facilitative support from other Armstrong Laboratory offices. The team's objective is difficult and the extent to which they can improve the lab's support to the field within the resources they have been provided is unclear at this point. However, if you are a customer of the laboratory, you can definitely expect that the team will be examining the process and your needs very closely in the upcoming months.

BASE: OLAC-PL-WEST/SEH
BASE CODE: 0057U
SAMPLE NUMBER: 93040014

DATE: 930902
DIVISION: OEA

ARMSTRONG LABORATORY CUSTOMER SATISFACTION SURVEY

This survey helps us improve our service to you. Your confidential answers will significantly impact on how we allocate resources to meet your needs. Please return it promptly. Thank you!

PLEASE CIRCLE YOUR RESPONSES BELOW USING THE FOLLOWING SCALE:

1	2	3	4	5	6
Extremely Dissatisfied	Dissatisfied	Slightly Dissatisfied	Slightly Satisfied	Satisfied	Extremely Satisfied
1. Timeliness: Did you receive your results within published time limits?				1	2 3 4 5 6
2. Accuracy: Is the report in the proper format? Are the address and other data correct?				1	2 3 4 5 6
3. Content: Does the report answer your questions and provide the necessary data?				1	2 3 4 5 6
4. Customer Support: Have we been courteous and helpful in meeting your special needs (priority service, reporting format, etc.)?				1	2 3 4 5 6
5. Consultation Service: Have we answered your questions and provided necessary materials or reviews to support your mission requirements?				1	2 3 4 5 6
6. Overall Rating: Do you enjoy doing business with us? Would you recommend us to others?				1	2 3 4 5 6
7. Suggestions: Are there other services that you would like us to provide in the future? (Please list them below.)					

COMMENTS: (Use the back of this form if more space is required)

RETURN TO: Armstrong Laboratory/ OEPQ
2404 E Drive
Brooks AFB, TX 78235-5114

From daemon Tue Apr 27 07:16 CDT 1993
Received: from MTF-ANDREWS.mednet.af.mil by hsdpl.brooks.af.mil with SMTP
Tue, 27 Apr 93 07:12:40 CST
Received: by MTF-ANDREWS.mednet.af.mil (5.59/25-eef)
id AA02362; Tue, 27 Apr 93 08:08:47 EDT
Message-Id: <9304271206.AA02362@MTF-ANDREWS.mednet.af.mil>
Received: from smtpmtf id: 2BDD2178.F03
? (WordPerfect SMTP Gateway V3.1a 04/27/92)
Received: from MTF-ANDREWS (WP Connection)
Received: from MGMC5 (WP Connection)
From: <corne]MTF-ANDREWS.mednet.af.mil> (Cornell Jeffrey)
To: <@hsdpl.brooks.af.mil:oakes@labux.brooks.af.mil>
Subject: (No Subject) (SMTP Id#: 11) - Reply
Date: Tue Apr 27 08:05:12 1993

Lab results received in good order on 26 Apr 93.

I love this system :) |||||

thanks,

jeff cornell

p.s. If there is anything i can do to help this effort (write letters,
collect info, etc.) please let me know! I feel like I'm actually in the
20th Century!

AL/OEA
2402 E DRIVE
BROOKS AFB, TEXAS, 78235-5114

In an effort to improve our support for you, we are testing a new cover letter for sending results. This procedure will contribute to shorter analytical turn around times. If your office has comments on this new procedure or any questions concerning analytical results or methods, please let us know in the Analytical Services Division at DSN 240-3626, commercial 210 536-3626, or via electronic mail at "ecs@oehlis.brooks.af.mil".

Enclosed you will find laboratory reports for the following samples:

BASE	AL/OE	BASE	AL/OE	BASE	AL/OE
SAMPLE #	SAMPLE #	SAMPLE #	SAMPLE #	SAMPLE #	SAMPLE #
CS930517	93040014	CS930518	93040015	CS930519	93040016
CS930520	93040017				

Reviewed by: _____

Thomas C. Thomas
Chief, Analytical Services Division

TO: OLAC-PL-WEST/SEH
EDWARDS AFB, CA 93523-5000